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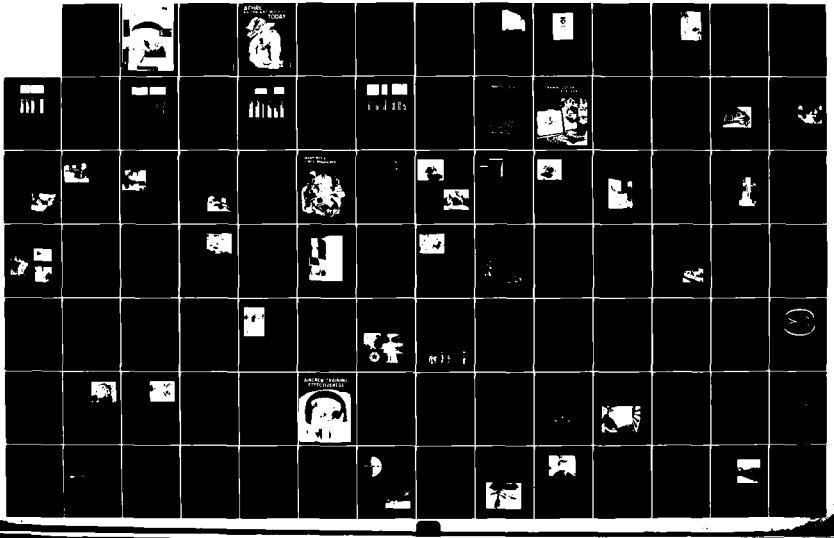

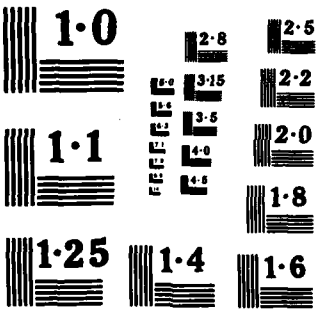
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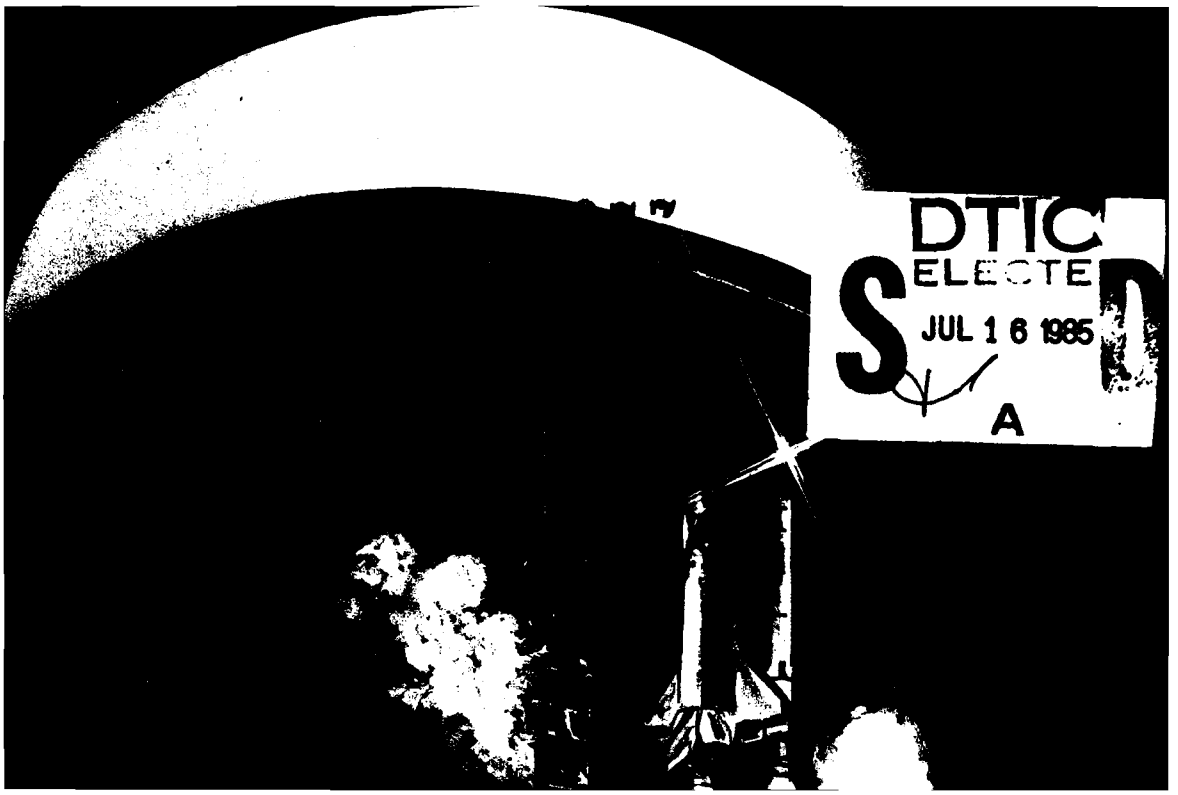
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AIR FORCE HUMAN RESOURCES LABORATORY (AFHRL)

A designated organizational element of the Air Force Systems Command, aligned under the Aerospace Medical Division.

ANTHONY F. BRONZO, JR., Colonel, USAF
Commander

DR. EARL A. ALLUISI
Chief Scientist

ACKNOWLEDGMENTS

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EDITOR: Ruth Buescher (AFHRL/TSR)

ILLUSTRATORS: Al Young & Mel Jordan (USAFSAM/TSY)

PHOTOGRAPHERS: Walt Weible & MSgt Buster Kellum (HQ USAF/RSACA)
Don Fike, University of Dayton Research Institute
and other anonymous Air Force photographers

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CONTACTS: A directory of AFHRL Command and Staff personnel and Division Chiefs is provided on the inside back cover. Points of contact are also given for each technical achievement and for each ongoing research and development project.

NOTE: The findings in this report are not to be construed as an official position of the Department of the Air Force, unless so designated by other authorized documents.

Department of the Air Force
AIR FORCE HUMAN RESOURCES LABORATORY
Brooks Air Force Base, Texas 78235-5000

AFHRL

BUILDING AIR FORCE 2000 TODAY

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AFHRL ANNUAL REPORT FY84

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"WE ARE AT A CHALLENGING AND EXCITING TIME IN THE EVOLUTION AND GROWTH OF THE U.S. AIR FORCE. WE ARE RAPIDLY MODERNIZING THE FORCE STRUCTURE OF OUR OPERATIONAL COMMANDS AND, AT THE SAME TIME, EXPLORING TECHNOLOGY, SYSTEM CONCEPTS, AND OPERATIONAL THEORIES TO BUILD THE AIR FORCE FOR THE YEAR 2000 AND BEYOND."

General Lawrence A. Skantze

AFHRL MISSION STATEMENT

To support the Air Force Mission,
Air Force Commanders,
and Air Force Personnel

Through Air Force Systems Command

By Technology Base R&D

In the Technology Areas of

Manpower and Personnel
Education and Training
Simulation and Training Devices
Logistics and Human Factors

ORIGIN

In the late 1960s, the Secretary of the Air Force and the Air Force Chief of Staff decided to redefine the Air Force's research and development (R&D) efforts in the related areas of personnel and training. In August 1967, the augmented Psychology and Social Sciences Panel of the USAF Scientific Advisory Board conducted a study concerning such R&D work. In its report, the board developed certain standards needed for a successful program: (a) the requirement for managers of these R&D efforts to possess and display a keen interest in the entire program, (b) the proper allocation of sufficient funding commensurate to the work being accomplished, (c) the acquisition and retention of well-trained and highly qualified people, (d) the recognition that the "human factor" involved in personnel and training R&D makes it a unique entity that cannot be compared to the hardware R&D in the Air Force's respective physical science laboratories, (e) the need for R&D functions to be geographically close to the organizations that most effectively applied the results of that R&D work, and (f) the need for a proper balance between finding solutions to current problems and the achievement of long-range R&D goals. On July 1, 1968, the Air Force Human Resources Laboratory (AFHRL) was established with an organizational structure that has allowed it to effectively carry out its mission over the last 17 years.

Alfred A. Boyd, Jr.
Retired 29 June 1984

THE POWER TO ENVISION THE FUTURE;

THE ABILITY TO SHAPE THE PRESENT;

THE WISDOM TO ACKNOWLEDGE THE PAST;

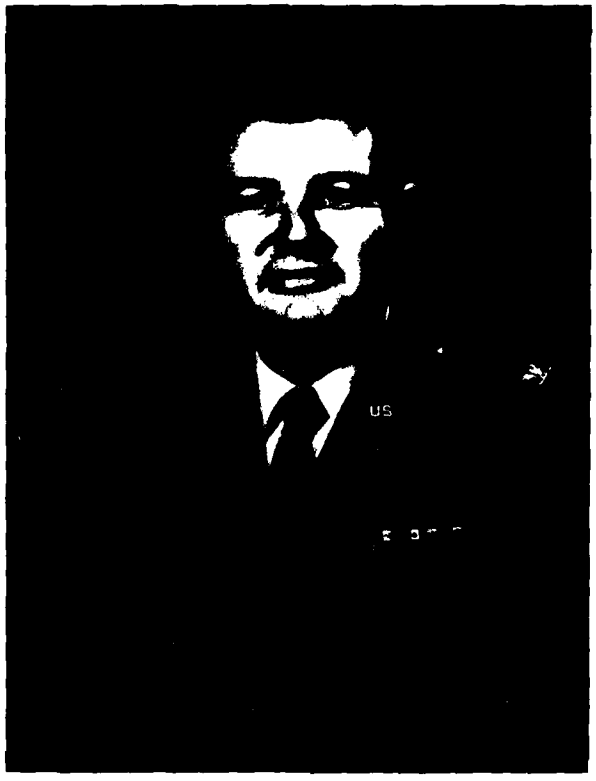
AND THE COURAGE TO KEEP A STRAIGHT COURSE.

ALL THESE ARE NOT YOURS ALONE,

FOR YOU'VE LEFT A LITTLE BEHIND IN EACH OF US.

C. Scott
March 1984

MESSAGE FROM THE COMMANDER



Colonel Anthony F. Bronzo, Jr., USAF
Commander

I want to express my satisfaction and pride in the work of our Laboratory, in my first message as AFHRL Commander. I want also to share with you my vision of its future.

I am extremely proud of the high quality of our work force and of our products. High levels of morale and productivity are apparent, both individually and corporately. It has been rewarding to note the consistent drive toward excellence in the work of our people. Largely through their efforts, AFHRL has become firmly established as the Air Force Center of Excellence in research and development (R&D) in the areas of education and training, manpower and personnel, simulation and training devices, and logistics and human factors--the manpower, personnel, training and logistics (MPT/L) areas.

Among the highlights of the management and technical initiatives taken during the past year are the following:

1. Completion of a professional-development plan to enhance the technical and managerial expertise of the individual, as well as the worker's sense of success, esteem, and self-actualization. An upward mobility program has been put into place for the civilian work force. A civilian personnel coordinator has been hired to assist us in developing and working continuing education and career broadening programs.

2. Completion of a comprehensive AFHRL 1990s Study that made recommendations on AFHRL functions and organization to meet future mission requirements as we play our key role in a totally integrated program with the Aerospace Medical Division R&D mission. It provided conclusions that represent the collective judgment of many persons of considerable talent with a wide range of expertise, and recommendations that provide a road map for the future. We have already begun effecting those recommendations,

to the benefit of our programs and ultimately of the Air Force.

3. Completion of an approved training-effectiveness R&D plan to provide needed data on the effectiveness of flight simulators as components of flying training systems, as well as on the human-performance parameters associated with simulator elements such as visual displays of different capabilities. Execution of this R&D plan, which is already underway, will provide critical information to impact the design, acquisition, and utilization of simulators.

I see, as I reflect on the Laboratory's history, that we have come far along the road of technology in answering the manpower, personnel, training, logistics, and human factors problems of the Air Force. We have contributed to the building of more effective air power. We have produced innovative and useful tools--good enough for yesterday and maybe today, but perhaps not good enough for tomorrow. As the Air Force Center of Excellence for MPT/L R&D, we must continue our efforts to match the person with the machine, in the systems context, and to effectively communicate those innovations to users. The development of excellent scientific and technical answers to future problems is not enough--we must also articulate those answers and transition the technologies developed in ways that will lead to improved Air Force performance.

As we look toward the 1990s and beyond, we are faced with challenges that are both exciting and demanding. The Laboratory is not now addressing in sufficient depth the critical technologies required for the space, strategic offense and defense, and mobility capabilities that the Air Force mission sets as objectives for the year 2000 and beyond.

For example, we all recognize that travel beyond our atmosphere is becoming almost routine. We can forecast that the future Air Force mission will include some kind of operations in space. There are likely to be manned space stations in the future. There may even be Air Force persons in space. What type of person do we select? How do we best train the persons selected? There will be ground systems and operators for them. We will need technologies to select and train people to operate and maintain these systems.

Characteristics of the Air Force beyond the year 2000 include emphasis on capabilities that emphasize dispersed, flexible, mobile, and sustainable operations. The operational environment is likely to include factors such as even more complex weapon systems, high information density, declining labor pools, and dormant systems. These conditions suggest that artificial intelligence would have widespread applications to many critical technology areas. AFHRL has initiated, and will continue vigorously to pursue, R&D to exploit further the advances of technology in artificial intelligence. For example, the space technician of the future will have to be a generalist, capable of interacting with a wide range of space system components. The expert systems/artificial intelligence technologies could provide the vehicle for leading the technician through both operational and troubleshooting (as well as other maintenance) performance requirements.

I have cited only a few directions AFHRL will be taking in its R&D during the years ahead, but for the Laboratory the challenge is clear! As we face the realities of tomorrow, we must also face how the Air Force person will be able to cope with tomorrow's weapons and possible wars. Our challenge is to do all that we can with our science and technology to make that person capable of an awesome task--the preservation of an unassailable and combat-successful fighting Air Force.

Anthony F. Bronzo, Jr., Colonel, USAF
Commander

CHIEF SCIENTIST'S REPORT

During FY84, the Laboratory initiated new programs and progressed in milestone achievements within its four major R&D thrust areas, each of which is designed to provide (or have the potential of providing) high payoffs to the entire Air Force.

Training Design and Delivery Thrust

Among the achievements that are contributing to improvements in Air Force technical training are the development of handbooks for maintenance training and Computer-Based Instruction (CBI), specifications of trainers for troubleshooting and nondestructive inspection, and instructional systems software for CBI-course authoring. A new initiative that moved from the planning to the execution phase has as its goal a technology demonstration of an advanced on-the-job training system for Air Force-wide use.

Specifically, three AFHRL-developed handbooks for the design, procurement, use, and logistics support of maintenance training simulators were applied operationally with reported improvements in systematic procedures for the acquisition of maintenance simulators. Use of the handbooks should result in the avoidance of unnecessarily high acquisition costs ranging to millions of dollars annually, with no loss in the training effectiveness of the devices so acquired. The Computer Assisted Instruction (CAI) handbook was prepared to aid Air Training Command (ATC) training managers in applying CAI to training courses. It provides an orientation, examples of possible applications of CAI, and aids to decisions regarding the selection and specification of instructional strategies. This handbook is now an official ATC pamphlet (ATCP 50-4).

R&D was undertaken for the Air Force Logistics Command (AFLC) to improve the reliability of Air Force Nondestructive Inspection (NDI) performance. AFHRL developed specifications for a stand-alone trainer for practicing ultrasonic NDI techniques at the job site. The concepts and specifications of such trainers have wide applicability in all four of the Military Services.

The Instructional System Software (ISS) is yet another R&D product with the potential of making a substantial impact on the efficiency and effectiveness of technical training within all four Military Services. The ISS is a computer-based, multimedia software package for the administration and management of CAI-individualized training. Written in the Ada computer language, the ISS can be used on a variety of computers, has modular construction, and can be installed on micro-computers. It is in use for B-1B training, and planned for use by ATC and the Aeronautical Systems Division (ASD). According to the ATC Vice Commander, the ISS will be used as a major step in modernizing ATC's CBI systems.

Dr. Earl A. Alluisi

The Advanced On-The-Job Training System (AOTS) is an ongoing R&D effort requested by HQ USAF. The AOTS is being designed as an integrated management and evaluation system for on-the-job training. It will identify training/performance requirements, recognize current and required training resources, provide training quality control, and automate training schedules. A subsequent phase may be undertaken to develop

(at the technology-demonstration level) a CBI training delivery system for operational wing/squadron on-the-job training. The AOTS development has the potential of substantially and beneficially impacting the entire Air Force technical training program.

Manpower and Force Management Thrust

In moving towards its goal of developing and demonstrating new technologies for Air Force use in the force acquisition, distribution, and management systems, AFHRL achieved numerous milestones in the areas of personnel qualification tests, job specification standards, and manpower and personnel models during FY84.

Continuing its R&D leadership in selection and classification testing, AFHRL developed norms and conversion tables for the Enlisted Screening Test for use in Air Force recruiting, validated the Air Force Officer Qualifying Test to predict success in technical training, and validated an Officer Training School and Reserve Officer Training Corps Selection System. Further, the Laboratory developed an aptitude selector for missile combat crews, and advanced the technology of computerized adaptive testing.

Among the Laboratory's most important contributions has been its continuing R&D on the Armed Services Vocational Aptitude Battery (ASVAB), for which the Air Force is the executive agency among the Military Services. The ASVAB support is one of the highest priority R&D requirements of the Air Force Manpower and Personnel Center. Benefits from the use of ASVAB include more efficient selection and classification, improved recruiting, and training cost-avoidance estimated to be many millions of dollars annually.

AFHRL continues to be widely recognized throughout the United States and allied Military Services as the center of excellence and technical expertise in occupational analyses and manpower management research. Some of the many achievements of substantial benefit to the Air Force in these areas during the past year include the evaluation of aptitude requirements of enlisted specialties in order to optimize talent allocation, improve personnel utilization, and enhance training; the determination of job strength-and-stamina requirements to provide physical-demand indices for incorporation into the Person-Job Match system; and the completion of a probe study that demonstrated the feasibility of the concepts involved in the planned development of an integrated system to assess basic job skills to improve enlisted classification, assignment, and training throughout the Air Force.

Aircrew Training Effectiveness Thrust

In its aircrew training effectiveness thrust, the Laboratory is developing technologies for flying training simulators and technology demonstrations of aircrew training systems.

Among the substantial achievements in flying training technology that have been developed and validated are guidelines to aid in the specification of performance measurement system requirements for future simulator acquisitions, and evaluations of generic part-task trainers and desk-top devices for training aircrew procedural tasks to demonstrate the utility of such low-cost technologies in aircrew training.

Among the major milestones achieved during the past year have been the improvement in visual display systems for training simulators and the enhancement of instructional design and software for flight-simulator use in flying-training settings. The AFHRL-developed Fiber-Optics Helmet-Mounted Display is a significant breakthrough in display technology with the promise of providing a new capability to train both air-to-air and air-to-ground maneuvers in a single simulator. The Advanced Visual Technology System, a computer-image generator system that provides imagery for the full spectrum of tactical air missions, represents a state-of-the-art advancement in flight-simulator display technology and serves as the primary source of technical guidance for operational flight-training simulator development in the Military Services.

Maintenance and Combat Support Thrust

The Laboratory has provided many substantial services of vital importance to the Air Force logistics-acquisition community and furthered the integration of manpower, personnel, training, and logistics factors in the weapon system acquisition process.

One outstanding project completed was the Combat Maintenance Capability effort that developed and demonstrated methods by which the Air Force can

measure, quantify, and improve combat maintenance capability, as well as systematically examine differences between peacetime and combat maintenance processes. In another effort, AFHRL completed an analysis of wartime functions, information flows, and command and control tasks in the Operational Support Center at the United States Air Forces in Europe (USAFE) Headquarters. This study was cited for special significance by the USAFE Commander in Europe and resulted in the initiation of a major R&D program to develop automated training and exercise aids for command and control personnel.

AFHRL developed and tested a fully automated logistics support analysis database management system that is already in use on the B-1B aircraft defensive avionics system. The success of this prototype unified database technology has led to a formal requirement by the Air Force Acquisition Logistics Center for development of an Air Force Industry standard. Implementation of this technology will optimize supportability in the weapon systems design process and substantially reduce long-range systems-support costs.

The Laboratory's efforts in computer-based maintenance aids represent a cornerstone of the Air Force program for automation of technical information. Tests and a field demonstration were conducted to determine how complex maintenance information at the shop level should be structured for effective electronic presentation using graphic terminal displays. A prototype system to store, retrieve, and present technical data for technicians at three different experience levels was tested in a B-52 aircraft maintenance shop, and will be evaluated for inclusion in the B-1B maintenance program. A follow-on effort was initiated to develop a portable computer display and aiding system for flightline use. Implementation of these systems will substantially reduce technical order costs and improve the use and access of maintenance instruction.

Laboratory-Wide Achievements

During FY84, numerous initiatives were taken and milestones achieved to increase the productivity, technical services, and management efficiency of the Laboratory. AFHRL continued its leadership in developing automated personnel and training databases and in providing computer-based statistical analysis techniques that support the entire spectrum of human resources R&D.

More than 450 computer-based studies were processed for Laboratory programs in addition to many studies accomplished for other Air Force and Defense organizations. An office automation benefit study identified benefits exceeding system costs by $1,000 for each administrative employee annually. The recommendations of this study will be implemented as part of the AFSC Local On-Line Network System (LONS). The Laboratory continued to enhance its information-exchange and technology-transfer program through its publications (technical papers and reports, as well as newsletters and brochures).

Finally, a major milestone was the completion of the comprehensive AFHRL 1990 Study that reviewed the Laboratory's mission, roles, and functions, and made recommendations on Laboratory functions and organization to meet future mission requirements documented by the AFSC 1990 and Air Force 2000 Studies.

Title: INSTRUCTIONAL SUPPORT SOFTWARE SYSTEM

AFHRL Contact: Alan P. Marshall
AFHRL/IDC
Lowry AFB, CO 80230-5000
Commercial (303) 370-4385
AUTOVON 926-4385

Description: AFHRL developed a large-scale Computer-Based Instructional (CBI) system employing both Computer-Aided Instruction (CAI) and Computer-Managed Instruction (CMI) techniques. The system was originally designed to support a very large number of students in a variety of different training courses, and simultaneously, to support research efforts on technical training issues. Research and development has now progressed to the point that transfer of this technology to the operational community (i.e., major commands and other DoD agencies) is timely. This technology must be affordable, maintainable, and a current state-of-the-art product. When fully developed and tested, the ISS will provide that product.

FY84 Milestones: Work on the development machine was essentially completed, and the majority of efforts were directed at the microcomputer implementation. Most of the CAI software was successfully implemented on the microcomputer, with the CMI software nearing completion. In addition, work was started on the various user manuals of the system. Operational testing of the VAX-based version was started. Completion of the effort is scheduled for March 1985.

Utilization: The principle purpose of this effort is to develop and demonstrate that one or more of the functional components of this CBI system can reside and execute on small, affordable mini/microcomputers. This is accomplished by converting the CBI software to the DoD standard high-order language Ada. The development machine for this effort is a Digital Equipment Corporation VAX 11/780 computer. The small microcomputer is a Motorola 68000 based system. Because of the use of Ada and the modular construction of the software, a wide range of other computer hardware is available as future candidates for implementation. The end result is a government-owned CBI software package that is machine and operating system independent. As new advances in hardware and software become available, the CBI package can easily be modified to take advantage of these. Therefore, any organization selecting this CBI package will not be tied to a particular vendor-supplied hardware/software package, but can select the best configuration to satisfy their local needs based upon their available resources. Use of the government CBI system will promote better trained personnel, and at the same time reduce training costs since loss of operational time and temporary travel costs can be avoided. It will also allow each site to locally tailor the system to their unique requirements, rather than trying to modify their requirements to fit the system.

Converting Instructional Software into DoD Standard Programming Language

Title: TRI-SERVICE INSTRUCTIONAL APPLICATIONS DELIVERY SYSTEM

AFHRL Contact: Lt Col David L. Pohlman
AFHRL/ID
Lowry AFB, CO 80230
Commercial (303) 370-7624
AUTOVON 926-7624

Description: The Tri-Service Instructional Applications Delivery System (TRIADS) is a Joint-Services effort to develop a family of

Thus a prototype Flight Simulator Troubleshooting Trainer was designed, developed, and then tested in the operational environment at the 380th AMS at Plattsburgh AFB, NY. The FSTT was used to provide troubleshooting training for the F-111 flight simulator.

FY84 Milestones: During FY84 the FSTT was tested and the following report was published: AFHRL-TP-84-9, Situational Interactive Micro/Graphic Simulator system for Improving Maintenance. Although based on a limited sample size, the evaluation showed the FSTT trained personnel performed significantly better in a performance test correcting malfunctions placed in the actual equipment.

Utilization: Although the microfiche-based FSTT proved successful, it has been returned from the site since even more cost-effective and reliable systems are now possible. Videodisc-based systems are currently available for about one-third the cost. The training courseware/content development for the device, however, is being maintained for possible future application.

Benefits: This R&D has shown that a training simulator can produce positive training results in the operational environment and that simulators are viable alternatives to training on actual equipment. Simulators can provide the operational commander with better trained personnel at a lower cost than training on actual equipment.

Learning Troubleshooting Maintenance Skills
on an Interactive Graphics Simulator

can be used in developing training for maintenance systems. This device and software continues to serve as a test bed for future maintenance training research investigations.

Benefits: This R&D demonstrated that IGS maintenance simulators are effective in troubleshooting training. The IGS has proved more reliable, safer, and versatile than actual equipment trainers in technical schools. The IGS acquisition cost was three times less than an actual equipment trainer, with better training effectiveness on a troubleshooting test, and equal effectiveness for a hands-on operational test.

TITLE: SYNTHESIS MAINTENANCE SIMULATOR HANDBOOKS AND TECHNICAL REPORT

AFHRL Contact: Capt Randy H. Massey
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
AUTOVON 926-2482

Description: There is little information available on the acquisition and evaluation of effective maintenance simulators, even though maintenance simulators (MSs) are becoming an increasingly commonplace and important component in military maintenance training programs. The primary objective of this effort was to update three Maintenance Simulator Handbooks that are widely used by both Air Force and DoD personnel involved in the designing, procuring, logistical support, and use of maintenance simulators. The handbooks have been updated and are in use by procurement agencies. A sample of students, instructors, and other personnel who had experience using maintenance simulators was included in this study. An interviewer visited the locations of 28 selected maintenance simulators collecting interviews and survey data from students and other personnel who were knowledgeable and experienced with that trainer. Data obtained were used to update and fill in the gaps of the first three aforementioned maintenance simulator handbooks.

FY84 Milestones: AFHRL-TP-84-43, Maintenance Training Equipment: Design Specification Based on Instructional System Development, AFHRL-TP-84-44, Maintenance Training Simulators: Prime Item Development Specification, and AFHRL-TP-84-49, Maintenance Training Simulators: Logistical Support Cost Considerations in the Design and Acquisition.

Utilization: The ISD handbook provides a systematic and detailed procedure to communicate a specific MS equipment training design to the System Program Office (SPO) responsible for trainer acquisitions. The Prime Item handbook provides a systematic standard procedure with detailed guidance (to include lessons learned from previous procurement acquisitions) for writing appropriate and detailed MS procurement specifications. The logistical support cost handbook systematically covers MS cost consideration factors according to seven logistical support phases.

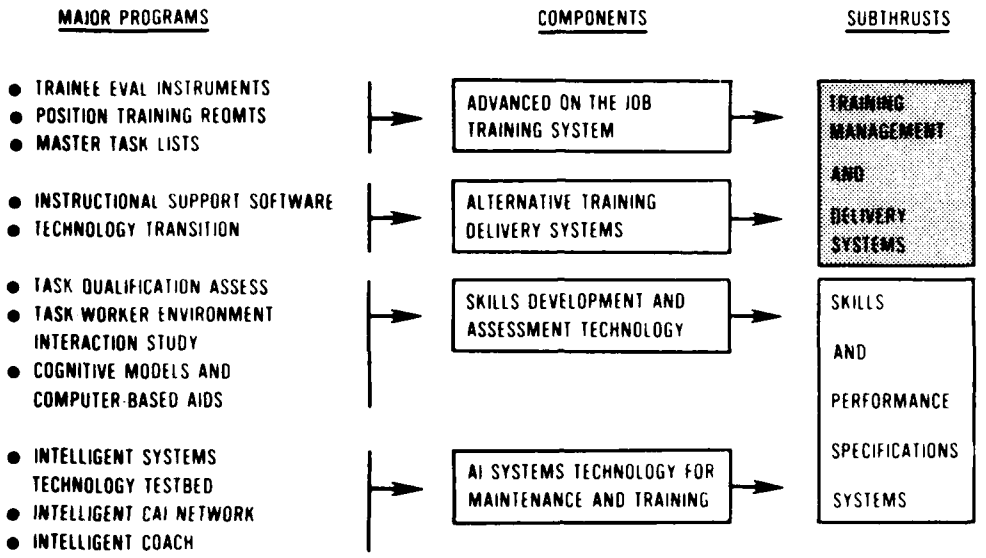
Benefits: This effort provided information to training, engineering, procurement, and other personnel on the effective design, acquisition, and use of maintenance simulators. Because of the complexity of procuring maintenance simulators, failure to use these handbooks and technical report substantially increases the probability of a procurement failure in obtaining a cost- and training-effective maintenance trainer device.

TITLE: FLIGHT SIMULATOR TROUBLESHOOTING TRAINER

AFHRL Contact: Maj Dale Baxter
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
Autovon 926-2482

Description: Flight simulators are effective training devices for learning, practicing, and maintaining aircrew skills. Because of the high utilization of these devices, there is little time for maintenance and even less time available to use the devices to train technicians to perform maintenance, troubleshoot, and correct malfunctions. In addition to limited availability, there are other restrictions on the use of actual simulators for training purposes such as safety considerations, potential damage to the equipment, and difficulty in inserting malfunctions for maintenance training purposes.

TRAINING DESIGN AND DELIVERY THRUST



TRAINING MANAGEMENT AND DELIVERY SYSTEMS — TECHNICAL ACHIEVEMENTS

TITLE: INTERACTIVE GRAPHICS SIMULATOR TRAINER FOR INTERMEDIATE LEVEL MAINTENANCE TRAINING

AFHRL Contact: Capt Randy H. Massey
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
AUTOVON 926-2482

Description: The need to have adequate numbers of competent electronic technicians due to high attrition rates and the shrinking qualified manpower pool is a challenge to the military. The main objective of this project was to demonstrate the feasibility of using a low fidelity (videodisc-based simulator) as a cost-effective adjunct to train for the 6883 Converter/Flight Control Test Station.

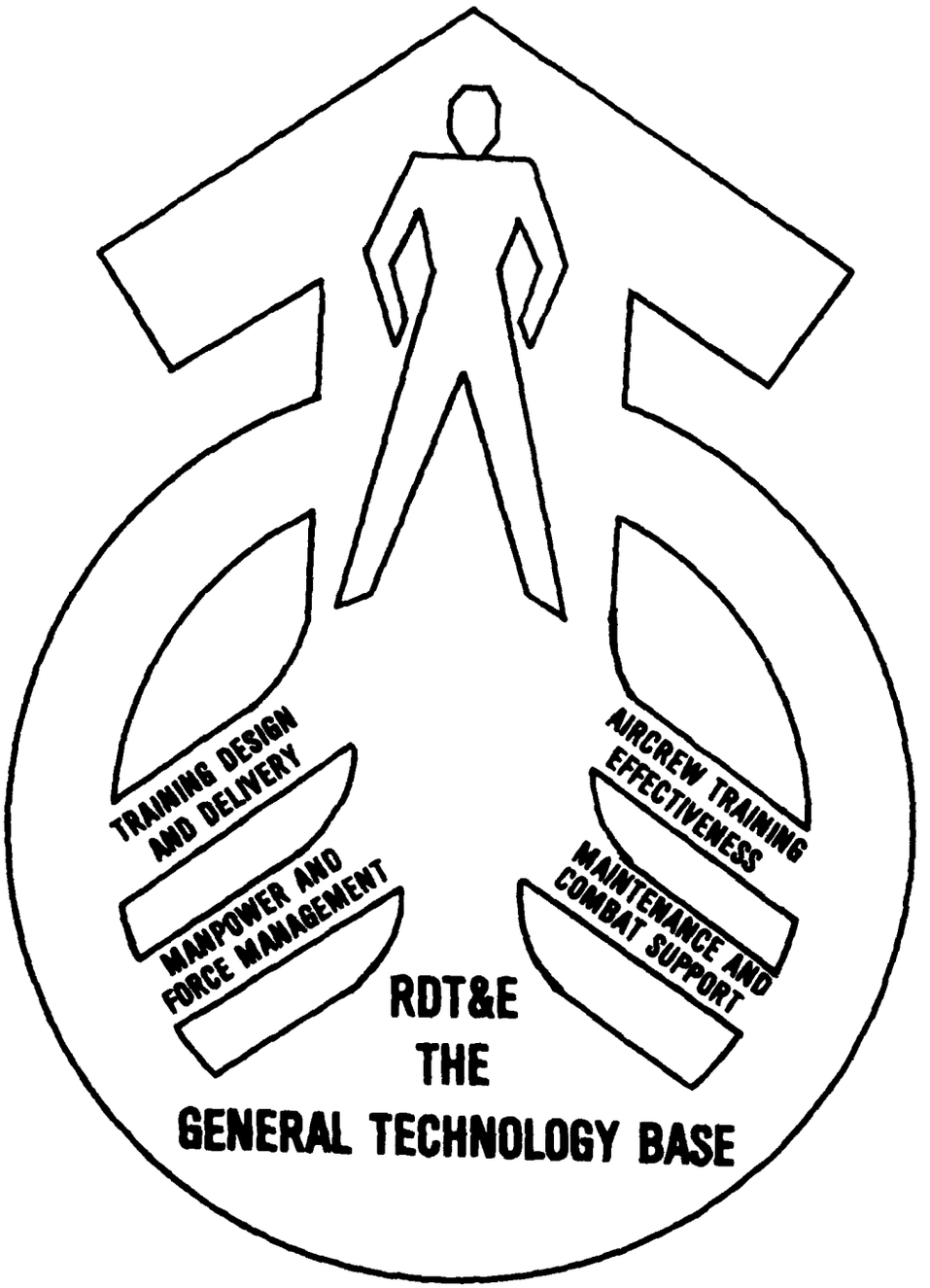
Students were randomly assigned to one of two training modes: actual equipment trainer (AET) training or Interactive Graphics Simulation (IGS) training. IGS students performed significantly better on a troubleshooting test than did the AET-trained students, on a 2-hour test consisting of six troubleshooting problems. There were no significant differences found on several other pre/post assessment measures which included a hands-on performance test on the 6883 test station. It was interesting to note that the IGS students (who were never exposed to the 6883 actual test equipment) performed as well on the hands-on 6883 procedures test, as those AET students who actually received training on the 6883 test station. Many training advantages of using IGS, rather than the AET, were noted. Students acceptance and perceived effectiveness were also higher for the IGS students, than for the AET-trained students.

FY84 Milestones: This effort was completed with the publication of AFHRL-TR-84-38, Interactive Graphics Simulator: Design, Development and Effectiveness/Cost Evaluation.

Utilization: This research has produced a demonstrated cost- and training-effective part-task maintenance simulator trainer for developing and practicing troubleshooting maintenance skills. The study provided valuable information about designing and producing graphics simulations, and the effectiveness of such devices when properly used. The results of this effort

TRAINING DESIGN & DELIVERY

COMBAT SUCCESS



MAINTENANCE AND COMBAT SUPPORT

The Logistics and Human Factors Division conducted structured interviews and collected survey responses from F-16 maintenance personnel in the continental United States, in the Pacific, and in Europe. The data collecting process asked for expert opinions on task-time requirements both for peace and wartime. The results of this effort will provide methodologies for analyzing the difference between peacetime and combat aircraft maintenance and the effects of the difference on sortie generation capability. This Division is developing a portable computer-based maintenance aids system for flight line use. Automated technical data has the potential for replacing much of the costly and cumbersome paperwork with an efficient, easy-to-access, easy-to-update digital database.

Also under development is a prototype computer-based maintenance aids system that will consist of a graphics terminal and a minicomputer that will be installed at an intermediate-level B-25 aircraft maintenance shop at Offutt AFB, Nebraska. There the prototype will be evaluated by measuring the effectiveness of technicians using the system in performing maintenance on a test-bed system. The results of the evaluation will be used to develop system specifications for the procurement of technical data for future weapon systems. In another effort algorithms were developed using "strawman" wartime demand rates to compute electronic countermeasures equipment needed for combat. The methods developed will aid Air Force manpower and logistics planning for wartime scenarios.

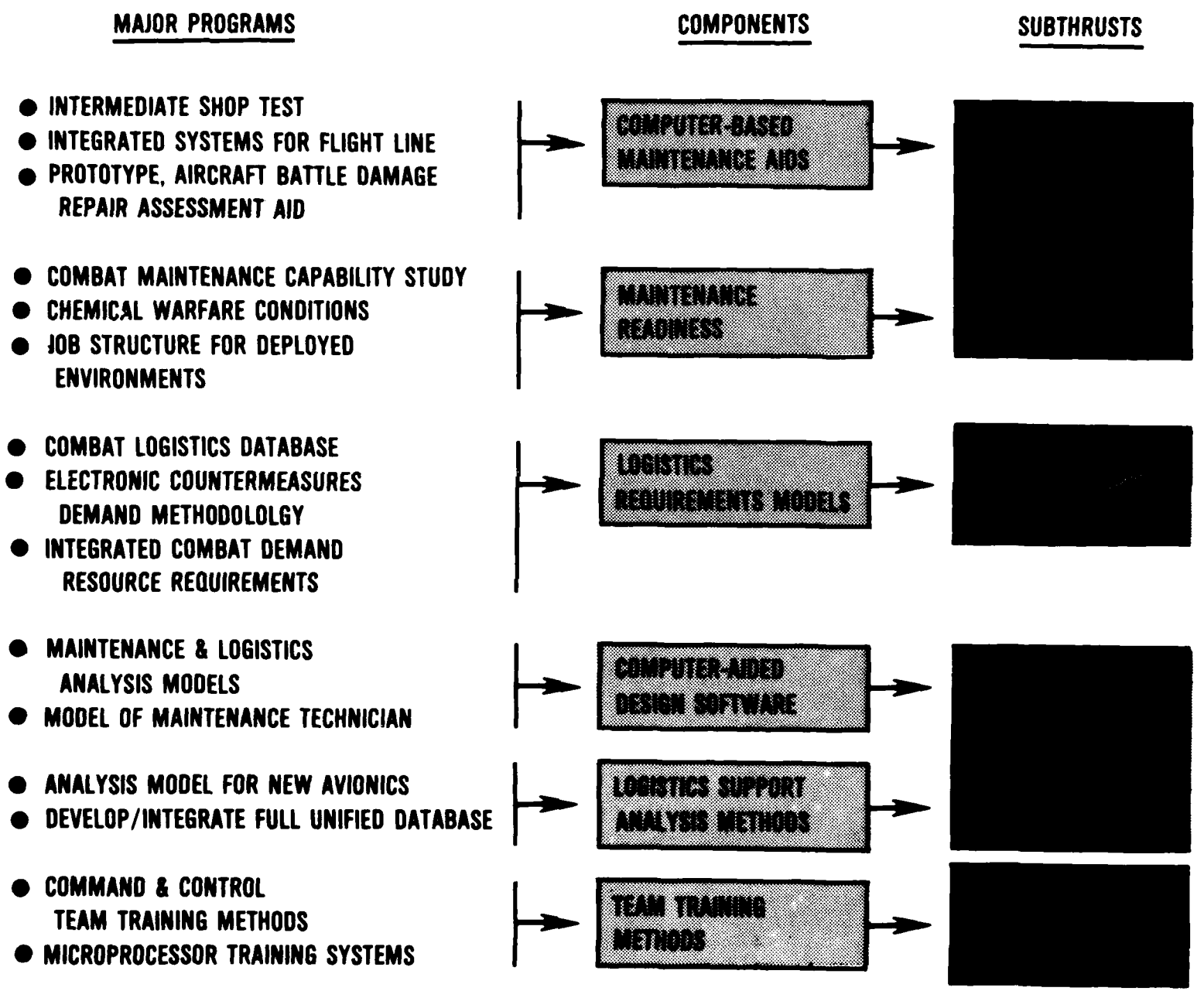
Scientists are working to incorporate logistics supportability considerations into the early stages of computer-aided design of weapon systems. When perfected, this technology will improve weapons, reduce turnaround times, improve mission reliability, and reduce logistics pipeline requirements. Crew chief, a three-dimensional, computer graphics model of the maintenance technician, is being developed for use in computer-aided design evaluations of proposed equipment. Final products will include math models and computer software representing the maintenance technician; databases depicting male and female body sizes, strength, and visual capabilities; validation data of the utility model; and user manuals for operation of the model.

A unified database technology is being developed for a central automated source of logistics data drawn from basic Air Force systems to support the weapon systems development process. The full system will be tested and demonstrated on a representative weapon system acquisition program. After testing it will be transitioned to the Air Force Acquisition Logistics Center where it can be provided as a government-furnished program to contractors for use in weapon systems development. Another project was designed to identify tools and techniques for incorporating logistics engineering parameters into system design during the conceptual phase. The major tasks involve developing front-end analysis techniques in the areas of logistics support, reliability, supportability, and fault tolerance.

A feasibility plan, known as the combat planning and attack capability, was based on the assumption that on identified and trained cadre of command and control professionals can significantly enhance wartime readiness. Data collection consisted of in-depth interviews, review of existing documentation and on-site observations at command post exercises and field exercises. The plan documents the current capability for training and management of key tactical command and control battlestaffs and battle managers, identifies future requirements and suggests options for achieving the desired capability.

An analysis was performed to identify ways that wartime-essential information flow and command decision processes could be improved. Likewise, ways of improving current system processes and capabilities through new methods of training, automation and management were identified. Many of the conclusions and recommendations from this effort have influenced planning for the Operations Support Center automation and organizational management initiatives. The objective of the Tactical Air Operations Planning System is to gather data on tactical decision making and provide training on generating Air Tasking Orders for combat planners in a Tactical Air Control Center.

MAINTENANCE AND COMBAT SUPPORT THRUST



AIRCREW TRAINING EFFECTIVENESS

The Operations Training Division developed and validated a unitary measure of A-10 pilot performance for simulated close air support missions. This Division also conducted a follow-on operational test and evaluation of the C-130 Weapon System Trainer. Three investigations showed that, in each case the WST training improved subsequent performance in-flight.

In an ongoing project scientists are developing a set of guidelines to aid in the specification of performance measurement system requirements for future simulator acquisitions. Likewise, an air combat measurement capability is being designed for the Simulator for Air-to-Air Combat and the Air Combat Maneuvering Instrumentation systems. In an effort to streamline aircrew training, this Division is conducting a series of opinion surveys of operational aircrew personnel to determine their perceptions about the effectiveness of aircrew training and the potential use of new low-cost microcomputer-based technologies to support this training.

Scientists collected data on a control group and a simulator-trained group of mission-qualified A-10 aircraft pilots. The performance of both groups at Green Flag, a combat exercise, was monitored and will serve as the basis for evaluation of the degree of transfer. In a related R&D project, measures of electronic combat performance are being developed to evaluate the effectiveness of current electronic combat training systems and to establish requirements for future systems. Another project proposes to apply advanced training development, delivery, evaluation, and management concepts to aircrew training. Integrating all phases of training into a single system should eliminate gaps and overlaps that currently exist, including those between formal schools and operational unit training.

Research into the application of artificial intelligence to pilot training is concerned with the cognitive determinants of visual attention and with developing an artificial intelligence model of pilot decision making in air-to-air combat maneuver selection. Results showed that dramatic improvements in the speed of voluntary attentional shifts within a single eye fixation can occur with training.

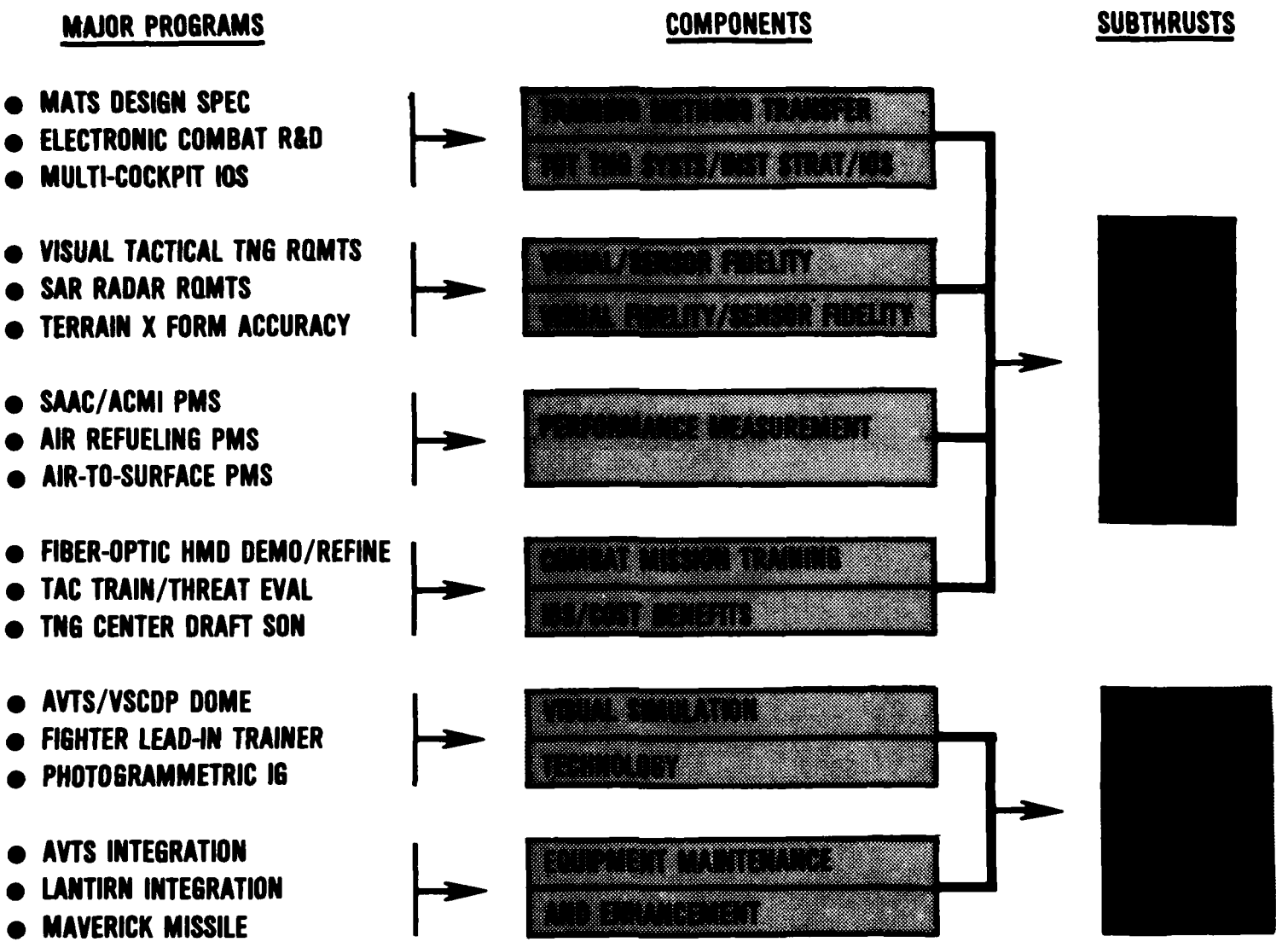
Operations Training Division scientists are working to develop and evaluate one or more generic microcomputer-based part-task trainers (MPTTs) as demonstrations of the utility of low-cost technologies for aircrew training applications. For many of the cognitive and procedural aspects of tasks performed by aircrews, MPTTs appear capable of providing the extensive amounts of practice associated with mastering the operation of complex weapon subsystems at reasonable costs.

AFHRL is providing technical assistance to the Military Airlift Command (MAC) in the form of instructional-design consultation, software review and critique, and conduct of field evaluations of several experimental systems. These are relatively inexpensive desk-top devices for training aircrews to perform various aircrew procedural tasks. For the Tactical Air Command this Division developed a Radar Warning Receiver and Electronic Countermeasures part-task trainer. The products developed in support of this R&D include radar warning receivers and electronic countermeasures systems for six TAC aircraft for a total of 25 different systems. The software that generates the simulation is compatible with the computers TAC has purchased for use in the operational squadrons; thus, the cost of the part-task trainers will be extremely low.

A laboratory experiment was completed which addressed the suitability of currently available, limited-field-of-view visual display systems for simulator training applications such as the A-10 close air support mission. The data suggest that both offensive and defensive aspects of tasks practiced under limited-field-of-view conditions will be negatively affected. During FY84, a front-end analysis was performed which addressed the utility of a major new training concept involving the colocation and functional integration of a multi-cockpit flight simulator facility and a state-of-the-art instrumented range. TAC pilots will practice simulated combat in the Low Altitude Navigation Targeting Infrared Night (LANTIRN) attack system at AFHRL thus providing TAC with a training capability that would be otherwise unavailable.

Scientists are developing a Fresnel lens which will convert a cathode-ray-tube real image into a virtual image such that the scene appears to be at real-world distances with minimum loss of brightness. The computer image generator being developed under the Advanced Visual Technology System project is designed to provide visual "out-the-window" imagery for the full spectrum of tactical air missions.

AIRCREW TRAINING EFFECTIVENESS THRUST



MANPOWER AND FORCE MANAGEMENT

The Armed Services Vocational Aptitude Battery (ASVAB), the single DoD enlistment qualification test since 1976, is scheduled to switch from a paper-and-pencil mode to a computer adaptive mode in 1988. AFHRL, with responsibility for providing the item pools for the Computer Adaptive Testing (CAT) system, has delivered nine such item pools. The Manpower and Personnel Division established an up-to-date (1980) reference group for ASVAB scores. Six new forms of the ASVAB were normed to this reference group. In addition, three versions of a new ASVAB form were implemented in 1984 for use in civilian high schools. Through the DoD Student Testing Program, it is estimated that 100,000 recruits use the ASVAB given in a single school year to qualify for military service. The DoD Student Testing Program allows military recruiting commands to identify and recruit service-eligible students who are in their last year of high school. High schools use the results for student guidance and counseling. This program also provides DoD with opportunities to share extensive experience in aptitude testing and occupational selection and classification with the civilian educational community.

The Manpower and Personnel Division developed an improved pilot selection system integrating the results of two computer-based tests of psychomotor ability with current selection data. For an example of the savings to be expected from the use of this system, screening at the 20th percentile of current entries would reject 29.5% of the failures using the psychomotor tests alone and 47.4% using the integrated selection system. At an average of $68,000 for each of the approximately 550 annual eliminees, the cost savings are impressive.

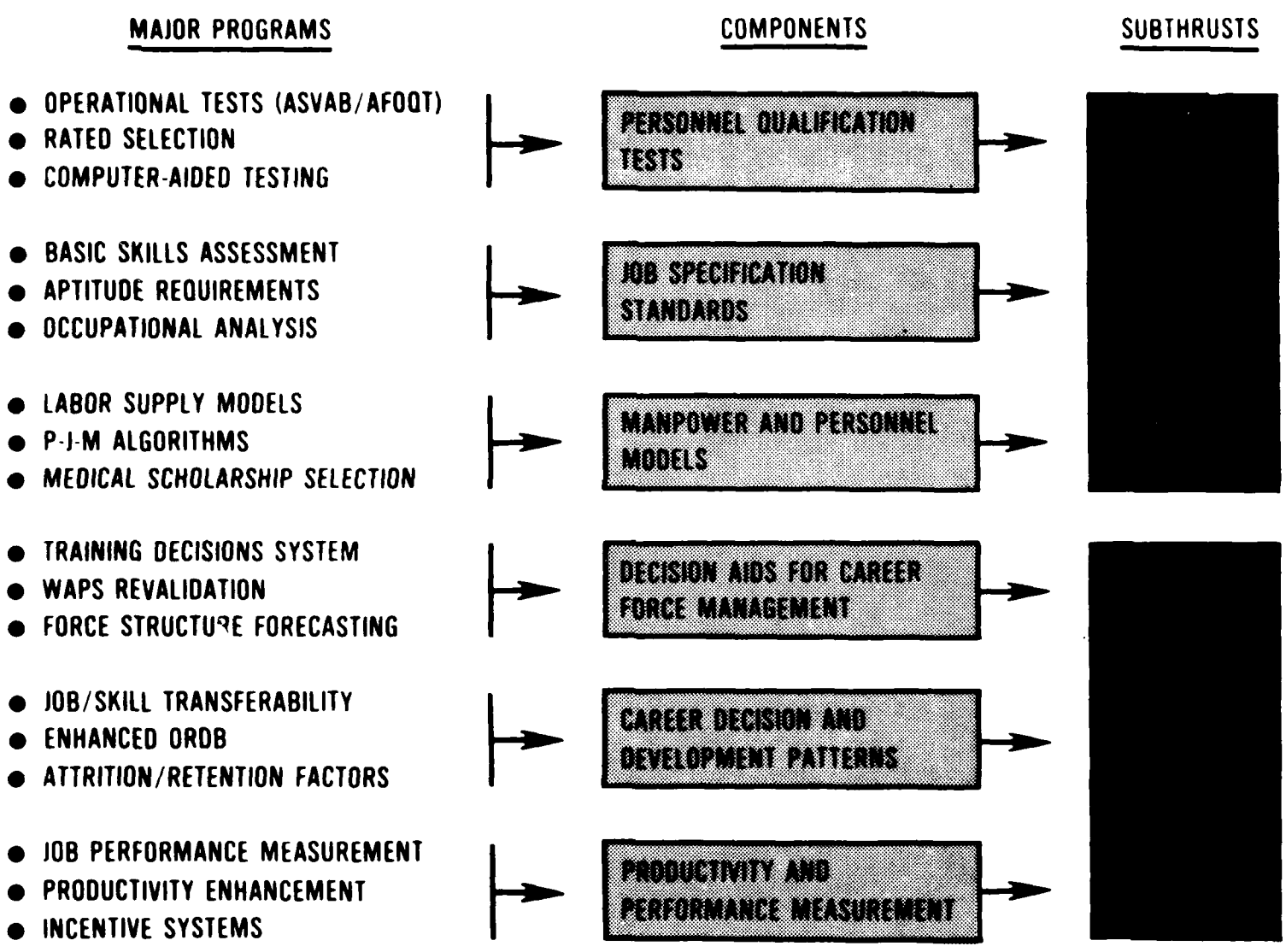
AFHRL scientists investigated the abilities of several judgment models to account for global strength-and-stamina ratings on Air Force jobs. Each model reflected differences of various kinds among ratings in different specialties. The measurement and practical issues that have been addressed in this effort will smooth the way for the development of physical demand indices to be incorporated into the Person-Job-Match system.

At the request of the Strategic Air Command, research is underway to determine the effectiveness of The Air Force Officer Qualifying Test (AFOQT) for screening candidates for missile operations assignments. Analysis results to date are promising and suggest that an AFOQT selector for minuteman duty would be expected to reduce attrition from technical training and improve overall quality of course graduates assigned to missile launch assignments.

A computerized Basic Attributes Test (BAT) has been developed. This testing system is designed to develop and implement a wide variety of human attributes tests with particular emphasis on information processing consistent with aircrew workload and perceptual/motor requirements. Work is currently underway to develop a portable version of the BAT system to facilitate the collection of test information at varying locations. Rather than having to transport people to the AFHRL facility for testing, the test systems will go to where the subjects are. This will reduce the costs of temporary duty assignments, increase the number and type of subjects being tested, and speed the R&D process by channeling more data into analysis.

The Learning Abilities Measurement Program (Project LAMP) is exploring ways to identify and define fundamental parameters of learning abilities. The primary objective is to develop ability measures that can be used to forecast the rate at which individuals will acquire skills and knowledge. A second objective is to forecast ultimate levels of performance capability. Basic research in personnel measurement is needed to rejuvenate a mature technology and to advance the state of the art.

MANPOWER AND FORCE MANAGEMENT THRUST



EXECUTIVE SUMMARY

This Annual Report presents the organization and activities of the Air Force Human Resources Laboratory (AFHRL) for Fiscal Year (FY84). The Laboratory's activities are reported as Technical Achievements or as Ongoing Research and Development (R&D). Additionally, the activities are presented in terms of the Laboratory's major thrusts: Training Design and Delivery, Manpower and Force Management, Aircrew Training Effectiveness, and Maintenance and Combat Support. Diagrams highlight the thrusts and subthrusts within which specific projects are performed.

TRAINING DESIGN AND DELIVERY

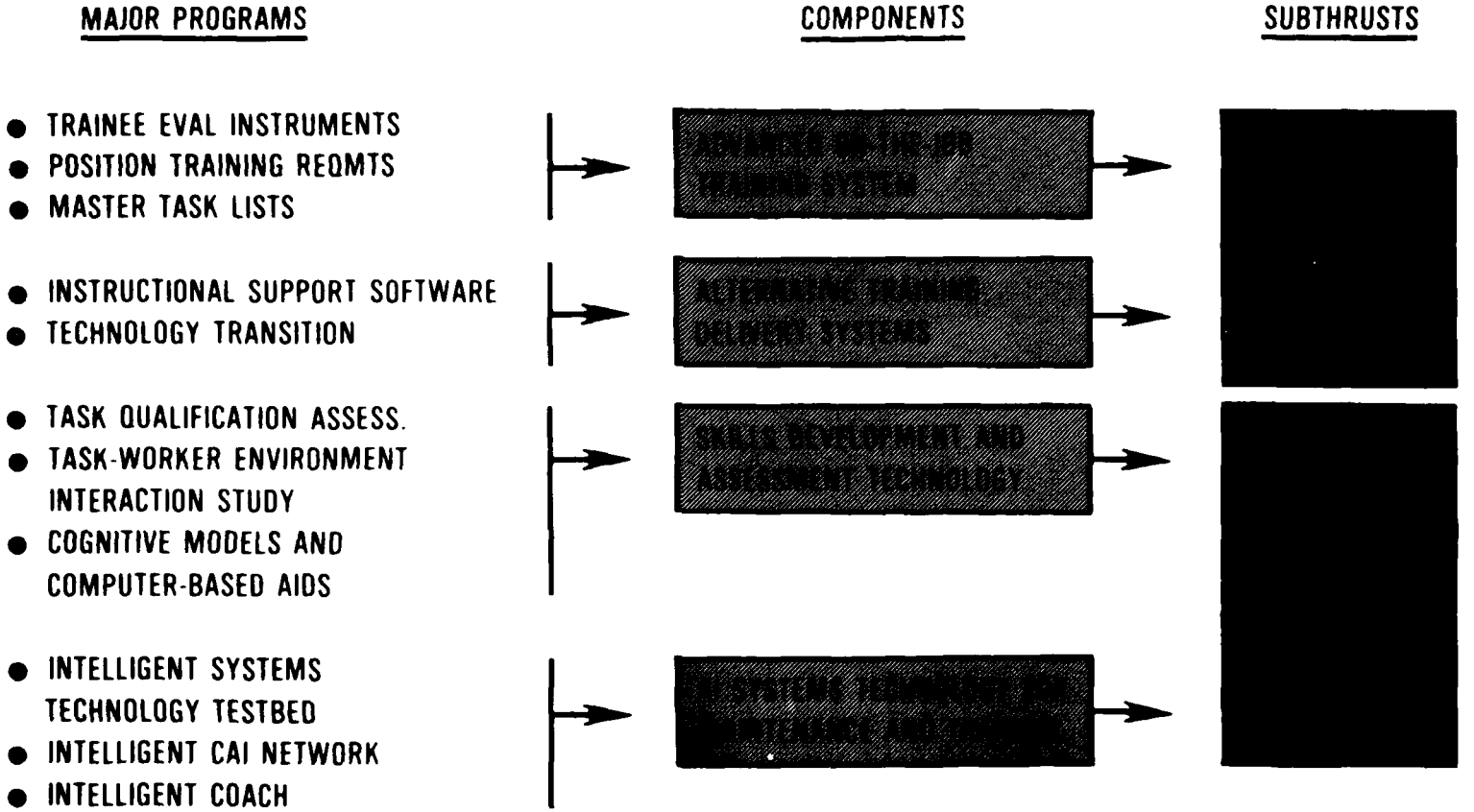
In support of its mission to provide the Air Force with improved training strategies, the Training Systems Division, Lowry AFB, Colorado, developed an Interactive Graphics Simulator (IGS) for maintenance training. Most maintenance training used actual equipment in short supply. This trainer was designed and evaluated to compare training on actual equipment to IGS training. The IGS has proved more reliable, safer, and versatile than actual equipment trainers in technical schools. The IGS acquisition cost was three times less than an actual equipment trainer, with better training effectiveness on a troubleshooting test, and equal effectiveness for a hands-on operational test.

Another example that training simulators can produce positive results in an operational environment and are viable alternatives to actual equipment was demonstrated in the Flight Simulator Troubleshooting Trainer. This prototype trainer was developed and then tested at an operational site to provide troubleshooting training for the F-111 flight simulator. Simulator-trained personnel did significantly better on a performance test than those trained on actual equipment. As noted by the 8th Air Force Commander, this trainer will enhance technician training and could be used in the B-1 program as well. Three AFHRL-developed handbooks for design, procurement and use/logistics support of maintenance simulator training devices were applied operationally, and resulted in improved systematic procedures for acquisition of maintenance simulators. Millions of dollars will be saved annually through lower acquisition costs and increased training effectiveness by using these handbooks.

AFHRL is culminating 10 years of R&D in computer-aided and computer-managed instruction techniques by transitioning these products across the DoD community. The Instructional Support Software (ISS) has been developed as an enhancement of the Advanced Instructional System. ISS provides software written in Ada, the DoD standard programming language, that can be used with mini and micro computers. Further, AFHRL is one component of a joint-Services group engaged in an effort to develop a family of hardware and software to support computer-based instruction in a variety of military and educational applications. The Tri-Service Instructional Applications Delivery System (TRIADS) will reduce the proliferation of single-purpose training systems and the associated maintenance, configuration management, and support problems. The Laboratory has also published a Computer-Assisted Instruction (CAI) Handbook, which gives a general orientation and suggested possible applications of CAI. This handbook provides guidance that will enhance the cost-effective use of CAI. Additional R&D identified factors contributing to successful implementation of self-paced instruction.

AFHRL has initiated and will continue to vigorously pursue R&D to exploit further the advances of technology in artificial intelligence. The Training Systems Division is investigating the ways in which artificial intelligence research can be practically applied to maintenance aiding, training, and organization support.

TRAINING DESIGN AND DELIVERY THRUST



hardware specifications and software to support computer-based instruction (CBI) in a variety of military training and educational applications. The software is in the form of a series of authoring editors which were designed so that the military subject matter expert can create computer based instruction and manage that instruction. The software is written in the DoD standard language Ada and does not depend on any certain computer configuration. It is also intended that the program will serve as a foundation for the creation of operational Military CBI Centers.

TRIADS is jointly sponsored by the Office of the Under Secretary of Defense for Research and Engineering, and the Joint Laboratory Commanders. It is being supported by a working group composed of representatives from the Air Force Human Resources Laboratory, the Army Research Institute for the Behavioral and Social Sciences, the Navy Personnel Research and Development Center, the Naval Training Equipment Center, and the Army Project Manager for Training Devices.

FY84 Milestones: The software development process was nearly completed in FY84. Large portions of the software began initial testing. Some additional funds were secured to convert the remaining non-Ada code to Ada. Site selection for the FY85 demonstrations was partially completed and included Carswell AFB, TX and Fort Rucker, AL. Additionally, four technical demonstrations were given at the request of various DoD agencies and three technical papers were presented.

Utilization: Because it is modularized and expandable, TRIADS software will be adaptable to most military training situations. It will embody the demonstrated capabilities of military R&D efforts in the areas of maintenance simulation and computer-based training. These capabilities will allow for increased training effectiveness, enhanced instructional management efficiency, and the possibility for effective job-aiding applications each of which will produce a corresponding increase in force readiness. There is a high potential for cost-savings that would warrant large-scale implementation of production versions. TRIADS will reduce the proliferation of single purpose training systems and the associated maintenance, configuration management, and support problems. The TRIADS program is intended to synthesize all the Services best efforts related to CBI technology. Initial programs contributed to the TRIADS library are those which have already received rigorous test and evaluation within the developing Service. Later programs will be accepted in the library only after such analyses have been conducted. Also, the demonstrations to be conducted will include cost/benefit analyses. Several recent studies of CBI in the Services have demonstrated the potential benefits of such systems. As the Defense Science Board noted, software and courseware development and maintenance are the major life-cycle cost elements. The TRIADS program is targeted at these costs; the intent is to reduce them by providing standard, well tested, supportable, efficient CBI programs, to avoid duplication of instructional software, and to achieve economies of scale.

Benefits: Where CBI has been determined to be appropriate for training, the TRIADS Software can reduce the cost of training system acquisition by as much as 50%. Both the software and hardware specifications are free. The use of in-house experts to develop courses assures the commander of mission relevant training. Better training will provide a more job competent individual, and a more efficient operation which results in an increase in combat readiness.

Computer-Based Instruction Will Form the Basis for a Variety of Military Training Programs

A Computer-Assisted Instruction Handbook Was Developed

Title: EFFECTIVE APPLICATION OF COMPUTER-ASSISTED INSTRUCTION WITHIN DIFFERENT INSTRUCTIONAL SETTINGS

AFHRL Contact: Maj Dale Baxter
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
AUTOVON 926-2482

Description: A Computer-Assisted Instruction (CAI) Decision Handbook was developed to provide information concerning: (1) the use of CAI, (2) trade-offs associated with the adoption of CAI, and (3) procedural decision aids for selecting appropriate levels of CAI. The handbook gives a general orientation and the suggested possible applications of CAI. The intent is to give personnel who make decisions concerning the use of CAI specific information and decision aids to help them specify requirements. Critical factors including hardware, software and courseware characteristics derived from an extensive experience base are discussed. Decision aids include two flow charts and a series of 12 worksheets to focus and guide the CAI instructional requirements decision process.

FY84 Milestones: The CAI Decision Handbook was published by Air Training Command as ATC Pamphlet 50-4, dated September 1984.

Utilization: This handbook is being used by ATC course managers and developers to determine when and where to apply CAI and to identify resource requirements.

Benefits: CAI has the potential to provide training in-house thus avoiding the time and cost of TDY to obtain training. This handbook provides guidance on the use of CAI to ensure the commander has better and more cost-effective training for his personnel.

Title: CRITICAL FACTORS ASSOCIATED WITH SELF-PACED INSTRUCTION IMPLEMENTATION

AFHRL Contact: Maj Dale Baxter
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
AUTOVON 926-2482

Description: This effort was a first step to systematically study factors which influence the successful implementation of a self-paced course. The approach taken was to identify candidate factors by analysing previous studies and using interviews and case study techniques to determine factors for examples of successful and unsuccessful implementations within the Air Training Command.

FY84 Milestones: In general, the major findings of this effort were that successful self-paced courses had certain distinguishable patterns. Flexible, creative, and knowledgeable managers, as well as high instructor dedication and motivation, are extremely important if implementation is to be successful. Many other design, resource utilization, personnel and student issues were judged to be important.

AFHRL-TP-84-24, "Factors Critical to the Implementation of Self-Paced Instruction: A Background Review" and AFHRL-TP-84-23 "Self-Paced Instruction: Factors Critical to Implementation in Air Force Technical Training - A Preliminary Inquiry" were published describing this effort.

Utilization: The results of this effort are useful for instructional system designers and

personnel involved in the design and implementation of new instructional technologies.

Benefits: By attending to the factors identified in this study, the incidence of unsuccessful implementations of self-paced instructional designs should be increased. Self-pacing can provide the commander with faster turn around for training of his personnel as trainees proceed in training at their own pace.

Factors Associated with Successful Self-Paced Instruction Were Identified

Title: COMPUTER-BASED INSTRUCTIONAL TECHNOLOGY TRANSITION

AFHRL Contact: Major Richard E. Bolz
AFHRL/IDC
Lowry AFB, CO 80230-5000
Commercial (303) 370-4386
AUTOVON 926-4386

Description: A state-of-the-art Computer-Based Training (CBT) system is of no value if it is kept on the shelf; it must actually contribute toward developing, supporting and maintaining a well-trained, combat-ready force. The following areas represent the AFHRL commitment to the transition of this technology to the rest of the Air Force and to other services.

(1) The National Security Agency (NSA) is plugged into the CDC CYBER computer of AFHRL/ID, Lowry AFB, CO. NSA is using the Advanced Instructional System (AIS) to generate computer-based training in support of this nation's communications intelligence effort.

(2) The Air Force Manpower Personnel Center (AFMPC) is currently using AIS (via AFHRL/ID) to develop and deliver CBT to enhance training in support of the Air Force Personnel system.

(3) The Air Training Command and AFHRL have two Memoranda of Agreement (MOA) relative to ISS. The first MOA involves the rehosting of ISS onto the ATC microcomputer, the XE500 from Burroughs. In the second MOA, AFHRL is assisting ATC/TT personnel to develop approximately 100 hours of courseware for their Electronics Principles course.

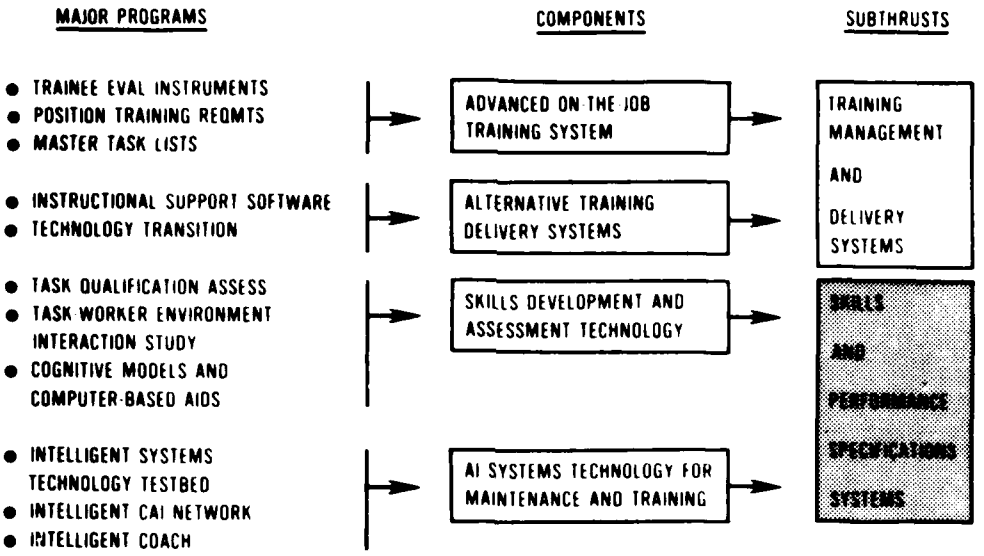
FY84 Milestones: Establishment of two MOAs with ATC for use of the Instructional Support System, Formalized support of SAC at Carswell and Beale AFBs, Conversion of AIS to ISS, and rehosting of ISS from mini- to microcomputer.

1984 saw the AFHRL support of Strategic Air Command (SAC) efforts grow significantly. The B1B program at Carswell AFB, TX started developing courseware on AIS on the CYBER and transitioned to ISS on the Vax 11/780 from Digital Equipment Corporation. In fact, the aircrew training effort is providing Operational Test and Evaluation (OT&E) support to AFHRL for the ISS effort.

In addition to the B1B relationship, AFHRL is supporting the 9th SRW at Beale AFB, CA as they generate CBT courseware using ISS on a Pacific Micro 16-bit machine. The Beale organization is serving as an OT&E site for the microcomputer version of ISS.

Utilization: CBT can provide improved, cost-effective training resulting in improved performance for DoD personnel. Transportability of courseware from computer system to computer system had been thought to be technically infeasible. The successful rehosting of ISS from the Vax 11/780 to the Pacific Microcomputer has shown that such transportability is, in fact, feasible. It is now possible to develop courseware which can operate, with only minor modification, across a wide range of existing computers.

SKILLS AND PERFORMANCE SPECIFICATIONS SYSTEMS



ONGOING R&D

Title: INTELLIGENT SYSTEMS TECHNOLOGY

AFHRL Contact: Major Hugh Burns
AFHRL/IDE
Lowry AFB, CO 80230
Commercial (303) 370-2482
AUTOVON 926-2482

Description: AFHRL's research and development program in intelligent systems is defining how fifth-generation computing technology can best be applied to Air Force training and job aiding.

FY84 Milestones: Together with the Denver Research Institute and General Dynamics, Air Force researchers examined the knowledge engineering issues involved in building intelligent expert systems. In cooperation with the Army Research Institute and Carnegie-Mellon University, intelligent tutorial systems are being investigated that will determine a trainee's performance level and deliver instruction accordingly. With the Naval Research Laboratory and the University of Pittsburgh, AFHRL AI researchers are participating on the Intelligent Computer-Assisted Instruction Network--a network connecting major academic laboratories investigating how artificial intelligence principles can best be applied in education and training.

Utilization: These efforts will provide the initial research and technology base for effectively applying artificial intelligence techniques to Air Force training and job aiding.

Benefits: The appropriate intelligent aiding and training technologies will provide a commander greater operational productivity because training features will be designed into job aids. Such smart systems will assist relatively inexperienced technicians to perform at higher levels.

Artificial Intelligence R&D Will Enhance Training and Instruction

Instructional Support Software Package: This is a computer-based training system written in the new DoD language, Ada, encompassing both CAI and CMI functions. It is a machine-independent, transportable, modularized package using small microcomputer to large mainframe systems. The system design is for use in small, single-user systems and all the way up to large instructional environments. This is a DoD software package available without software data rights restrictions.

ATC Pamphlet 50-4, CAI Handbook: This pamphlet presents specific tools, in the form of worksheets, for evaluating the need for CAI, for identifying configurations most closely matched to instructional needs and practices, and for estimating the feasibility of initiating CAI implementation.

Non-Destructive Inspection (NDI) Specifications: These specifications for the NDI stand-alone trainer have potentially wide applicability in the military non-destructive testing community. The specifications were delivered to the Air Force Logistics Command for their use in procuring a trainer for on-the-job training.

Instructional System Development (ISD) Handbook: The ISD Handbook provides a systematic and detailed procedure to communicate a specific equipment training design to the System Program Office (SPO) who are responsible for maintenance trainer acquisition. This handbook is useful to ISD teams during the development of training specifications for maintenance simulators. The Test and Evaluation Squadron at Edwards AFB, CA, has used this ISD handbook for the definition of functional requirements for more than 20 simulators.

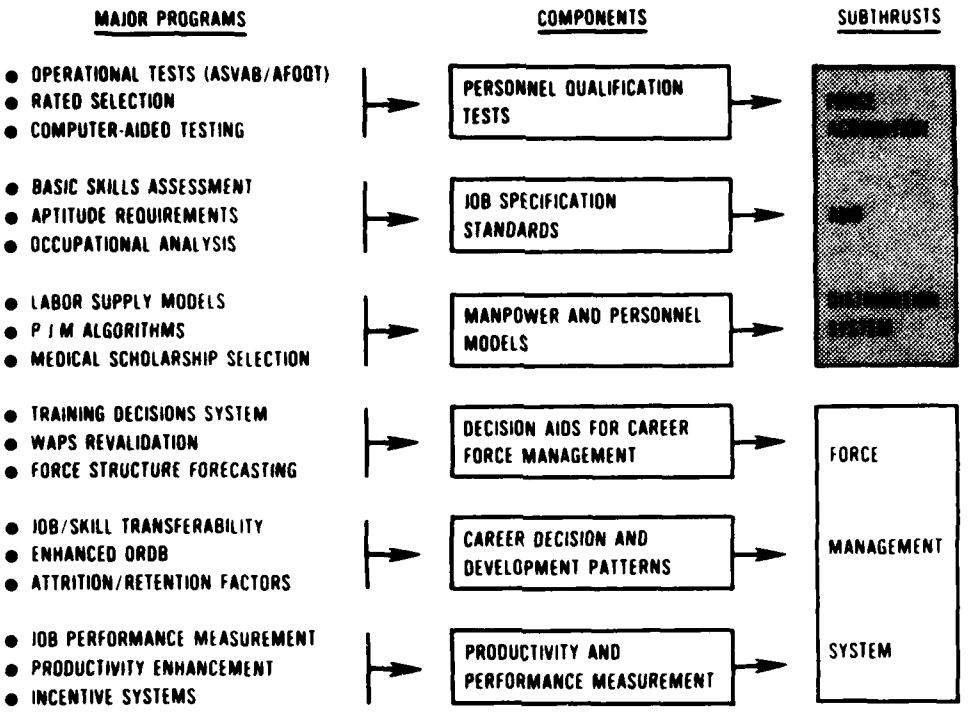
Prime Item Handbooks Specifications: This handbook provides a systematic and standard procedure (with detailed guidance to include lessons learned from previous procurements) for writing appropriate and detailed maintenance simulator specifications. SPO personnel at Wright-Patterson AFB, as well as other various Army and Navy personnel, are using this handbook in procuring maintenance trainers.

Logistics Handbook: This handbook provides information for potential users of simulators concerning logistics support considerations. It provides worksheets that can be used to plan and manage logistics support of simulators.

Interactive Graphics Simulator (IGS) Trainer: This low-fidelity, low-cost, IGS maintenance trainer was developed to compare its capability to provide troubleshooting training as compared to the actual equipment trainer. IGS was shown to be more reliable, flexible, and effective in teaching troubleshooting than the actual equipment trainer. Wide use of such devices can produce highly skilled electronic maintenance to meet mission requirements.

MANPOWER & FORCE MANAGEMENT

MANPOWER AND FORCE MANAGEMENT THRUST



FORCE ACQUISITION AND DISTRIBUTION SYSTEM — TECHNICAL ACHIEVEMENTS

Title: DEVELOPMENT OF 1980 YOUTH POPULATION NORMATIVE TABLES

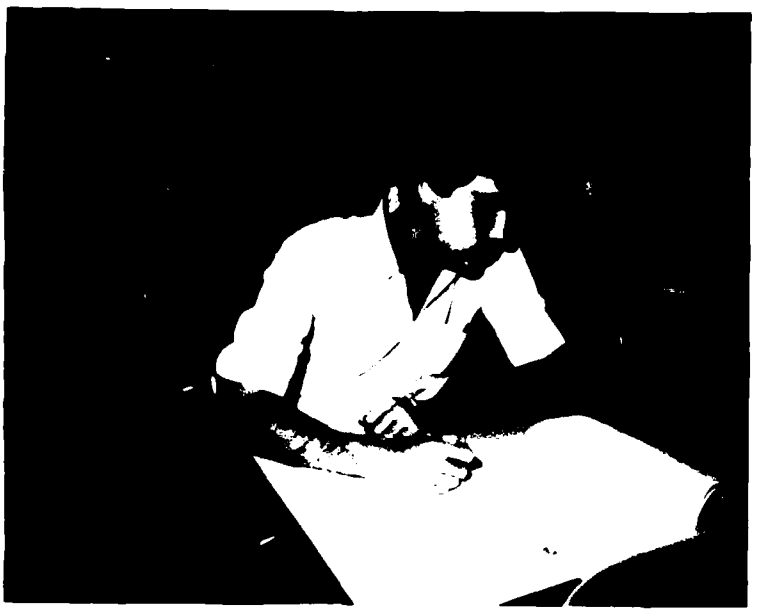
AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Armed Services Vocational Aptitude Battery (ASVAB) is the primary test for enlisted selection and classification for all the military services and for the Coast Guard. For the past 40 years, the scores on the ASVAB have been based on a 1944 reference group. In 1980, the Department of Defense had a broad sample of American youth tested on a version of the ASVAB. These data were provided to all the services for investigation, with a goal of instituting this sample (with appropriate 1980 census-based weights) as a new, up-to-date reference group.

FY84 Milestones: AFHRL, as the lead laboratory for ASVAB research and development, investigated the data, resolved anomalies, and provided conversion tables for the subtests for the Armed Forces Qualification Test and for the classification composites of all the services. The major data anomaly resolved was due to use of an answer sheet for the 1980 youth testing which deviated significantly from the operational answer sheet.

Utilization: The ASVAB scores for about one million applicants and one million high school students each year will be based on these normative tables. This will be true for all present and foreseeable-future ASVABs, whether they be paper-and-pencil or computer administered.

Benefits: ASVAB aptitude scores will be based on a much more recent reference group. Service manpower planners will be able to make decisions on service personnel requirements using knowledge on the available manpower pool.



Title: DEVELOPMENT AND NORMING OF ARMED SERVICES VOCATIONAL APTITUDE BATTERY FORMS 11, 12, AND 13

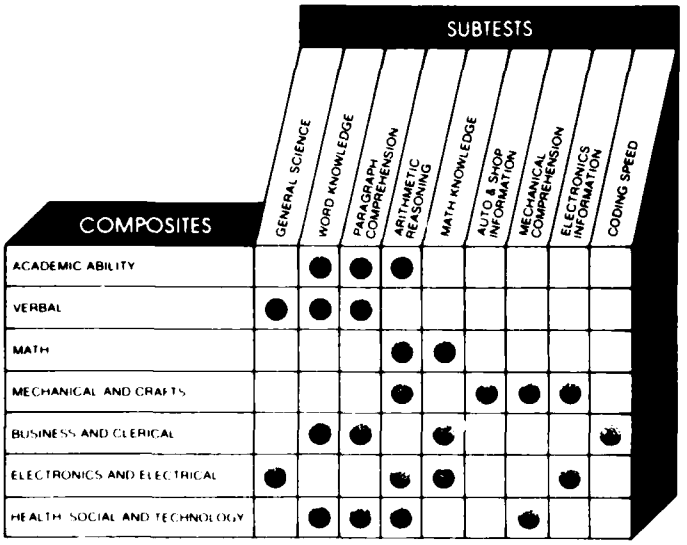
AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Armed Services Vocational Aptitude Battery (ASVAB) is the enlisted selection and classification instrument used by the Army, Navy, Marines, Air Force, and Coast Guard.

FY84 Milestones: Six new forms were developed for implementation on 1 October 1984. AFHRL applied equating techniques to norm various Services' selection and classification scores to a representative sample of American youth tested in 1980; previous ASVABs were referenced to a 1944 military mobilization population. Supporting materials such as administration instructions, answer keys, and a technical manual were developed.

Utilization: Approximately one million applicants to military enlisted service (plus Coast Guard) take the ASVAB annually. Military recruiting commands use the testing results to determine eligibility of applicants for service and for various military occupations.

Benefits: The development of new ASVAB forms provides the way to improve measurement of potential recruit aptitudes by the inclusion of new aptitude domains as well as refinement of test items in the traditional aptitude areas. The ASVAB allows the Air Force to select the best qualified 60,000 applicants each year from a pool of approximately 200,000 referred by recruiters for potential entry into service. Test scores indicate whether the recruit has the requisite aptitudes necessary for successful completion of technical training. The higher the probability of success in training, the lower the probability of academic attrition. By effective screening with the ASVAB, recruiter and training costs due to untimely attrition can be minimized. The need to norm the Air Force operational tests to a recent population became necessary to allow service personnel planners to base decisions for service entry requirements on knowledge about a more recent available manpower pool rather than the historical World War II mobilization population.



Matrix of Composites and ASVAB Subtests

Title: ESTABLISHMENT OF COMPOSITES AND NORMS FOR THE DEPARTMENT OF DEFENSE STUDENT TESTING PROGRAM

AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: Administration of the Armed Services Vocational Aptitude Battery (ASVAB) is offered free to civilian schools for use in guidance and counseling of students. A new student form--parallel to the current operational forms--was implemented at the start of the 1984-1985 school year.

FY84 Milestones: Test composites for the new ASVAB were developed through factor analysis and were empirically related to military service. Also, occupational composites were developed based on service validity studies. The institutional ASVAB was compared with several commercial test batteries, using samples of high school students. School grade and gender norms were developed on a nationally representative sample from the Profile of American Youth database. The results of studies involving the institutional ASVAB have been included in a counselor's manual and technical supplement for the use of school and recruiting service personnel.

Utilization: About one million high school students take the ASVAB annually. Military recruiting commands use these testing results to identify and recruit service-eligible students who are in their last year of high school.

Benefits: Service recruiters are provided lists of qualified students who have taken ASVAB; then, they contact educators, parents, and students to discuss military occupational and training opportunities. It is estimated that 100,000 recruits use the ASVAB in a single school year to qualify for military service.

Title: DEVELOPMENT OF 1980 NORMS AND CONVERSION TABLES FOR THE ENLISTMENT SCREENING TEST

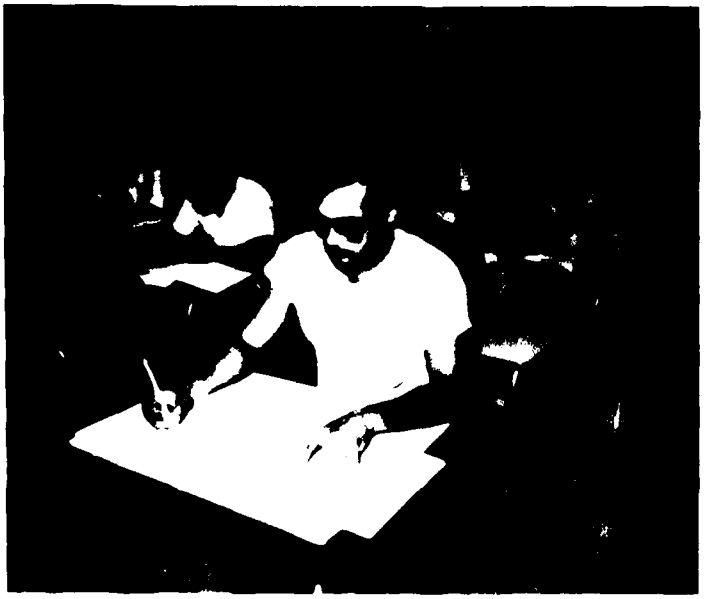
AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Enlistment Screening Test is a short test used to make estimates of an applicant's Armed Forces Qualification Test (AFQT) scores. The Enlistment Screening Test is administered and scored by recruiters, who use the results to help them decide which applicants should receive the limited travel funds that are reserved for sending individuals to centralized entry stations for Armed Services Vocational Aptitude Battery (ASVAB) testing.

FY84 Milestones. Tables for predicting AFQT scores in the new 1980 reference population were developed.

Utilization: Recruiters will use the new Enlistment Screening Test tables to estimate AFQT scores for applicants. This procedure is mandatory for Marine Corps recruiters and optional for recruiters from the other services.

Benefits: The estimated AFQT scores will help guide recruiters in their selection of applicants on whom to spend travel funds for official ASVAB testing.



The Enlisted Screening Test Being Administered at a Recruiting Station

Title: DEVELOPMENT OF COMPUTERIZED ADAPTIVE TESTING ITEM POOLS

AFHRL Contact: Major John R Welsh
AHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Armed Services Vocational Aptitude Battery (ASVAB) is currently scheduled to switch from a paper-and-pencil mode to a computer adaptive mode in 1988. An adaptive test presents the test taker with items that are most appropriate to that test taker's aptitude. Items that are clearly too easy or too hard are not presented.

A goal of computer-adaptive testing (CAT) is a more uniformly accurate measurement of service applicants' aptitudes from the high to the low end of the ability spectrum.

The paper-and-pencil ASVAB typically measures an aptitude area with about 25 items. A few items are easy, a few are hard, but most are of average difficulty. A CAT item pool requires many items at each difficulty level.

FY84 Milestones: AFHRL, with responsibility for providing the item pools for the CAT system, has delivered nine such item pools for CAT. The aptitude areas which are measurable with these item pools are General Science, Arithmetic Reasoning, Word Knowledge, Paragraph Comprehension, Auto Information, Shop Information, Mathematics Knowledge, Mechanical Knowledge, and Electronics Information.

Utilization: The nine item pools will be used to measure the aptitudes of all applicants for enlistment into all the military services (plus the Coast Guard) when CAT is implemented in 1988. These item pools will support aptitude measurement for the selection of applicants into the services and for their classification into job specialties.

Benefits: CAT, utilizing the large item pools, will measure applicant aptitude with increased accuracy at the high and low ends of the ability spectrum. ASVAB reliability and validity will be improved.

Title: INTEGRATED SELECTION SYSTEM FOR UNDERGRADUATE PILOT TRAINING

AFHRL Contact: Major V. Paul Bordelon
AFHRL/MOAA
Brooks AFB, TX 78235-5000
Commercial (512) 536-3222
AUTOVON 240-3222

Description: At the request of the Air Training Command, AFHRL designed and conducted an R&D effort to capitalize on state-of-the-art technologies to improve the way the Air Force selects people for pilot training. The improved pilot selection system was developed using a predictive validation approach to identify the best way to use two computer-based tests of psychomotor ability. Student pilots were tested prior to training, and analyses showed that the tests significantly predicted their actual graduation or elimination from Undergraduate Pilot Training (UPT). Then, the information from the experimental psychomotor tests was combined with current selection data (Air Force Officer Qualifying Test scores, age, and Flight Screening Program results) to produce a highly accurate Integrated Selection System for USAF pilot candidates.

FY84 Milestones: The psychomotor tests for UPT students about to graduate were evaluated using a concurrent validity approach. Students recommended for more demanding advanced training performed better on the psychomotor tests. The Integrated Selection System technology was transferred to Air Training Command (ATC) and several implementation options were evaluated.

Utilization: The improved selection system can be used by ATC to identify those people with an excellent chance of success in pilot training. With the advent of computerized test equipment, highly reliable test systems can be put into the field with minimal support required.

Benefits: Increased quality of the student pilots who would graduate, as well as a potential reduction in attrition, were demonstrated by this R&D. For an example of the savings to be expected from the use of these selection systems, screening at the 20th percentile of current entries would reject 29.5% of the potential failures using the psychomotor tests alone and 47.4% using the more accurate Integrated Selection System. At an average of $68,000 for each of the approximately 550 annual eliminees, the cost savings are impressive.

Psychomotor Testing Improves Pilot Selection

Title: OCCUPATIONAL LEARNING DIFFICULTY: TRANSFER OF A TASK MEASUREMENT TECHNOLOGY

AFHRL Contact: Joe Weeks
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: AFHRL Special Report 84-26 describes a task measurement technology developed for enlisted job specialties. When task information derived from this technology is combined with occupational survey information routinely collected by the USAF Occupational Measurement Center (USAFOMC), estimates of the learning difficulty of enlisted specialties can be produced. The value of occupational learning difficulty is that it represents a job-centered frame of reference for management decisions.

FY84 Milestones: Because occupational tasks are modified as a result of technological advancement and occupational restructuring, measures of task learning difficulty can become obsolete. To ensure that accurate measures of learning difficulty are available for management decisions, the task measurement technology must be reapplied after specialties undergo change. As a result, it is necessary to transfer the technology from the research to the operational domain. A significant 1984 milestone was the completion of a front-end analysis associated with technology transfer. The purpose of the analysis was to assess the feasibility of transferring the task measurement technology to USAFOMC. The analysis indicated that OMC personnel could apply the technology to produce estimates of occupational learning difficulty comparable to those derived in a research setting. Furthermore, a working group consisting of representatives from HQ ATC, HQ AFMPC, USAFOMC, and AFHRL was established. The objective of the working group is to identify technical issues and resource requirements associated with applying the technology on an operational basis.

Utilization: Measures of occupational learning difficulty are considered along with information concerning USAF policy, recruiting, and training priorities to determine aptitude requirement minimums stated in the Airman Classification Regulation (AFR 39-1). The purpose of this application is to ensure that specialties high in difficulty have high aptitude requirement minimums and those low in difficulty have low aptitude minimums. Also, learning difficulty information is used within the automated, Person-Job-Match system. Here, it is combined with measures of personnel aptitudes and information concerning USAF policy, recruiting, and training priorities to determine initial job offers for Air Force enlistees. The purpose of this application is to ensure that enlistees are offered job specialties commensurate with their aptitudes. In addition to applications concerning personnel utilization decisions, learning difficulty information is applied to training decisions. It has been submitted to HQ USAF where it is considered in the process of identifying the different skill categories.

Benefits: The benefits of using occupational learning difficulty information are best appreciated by considering results of ineffective personnel utilization. If high-aptitude enlistees are assigned to low-difficulty specialties, the result would be boredom. Alternately, if low-aptitude enlistees are assigned to high-difficulty specialties, the result would be frustration. In either case, the problem for wing commanders would be job dissatisfaction among personnel in their command. Reference to occupational learning difficulty information helps ensure that enlistees' aptitudes match the learning difficulty of the specialties to which they are assigned. Such a procedure contributes to effective personnel utilization and job satisfaction.

In addition to serving as a job-centered frame of reference for management decisions, occupational learning difficulty has served as the evidentiary basis for management procedures subjected to high-level inquiries and audits. For example, the application of learning difficulty for determining aptitude requirement minimums was reported to a Congressional Defense Advisory Committee investigating how the Air Force establishes aptitude requirement minimums. It has been submitted to HQ USAF where it is being used to justify Air Force personnel quality standards. This justification is being prepared in response to inquiries by the

Congressional Armed Services Committee in support of development of the 1985 Defense Appropriations Bill. Occupational learning difficulty has also served as the evidentiary basis for aptitude requirements which control entry into technical training. This application occurred in response to independent inquiries by the Air Force Audit Agency and the Government Accounting Office.

Title: STRENGTH AND STAMINA: FOLLOW-UP SURVEY REGRESSION ANALYSIS (PRELIMINARY PHASE: 8 AFSCs)

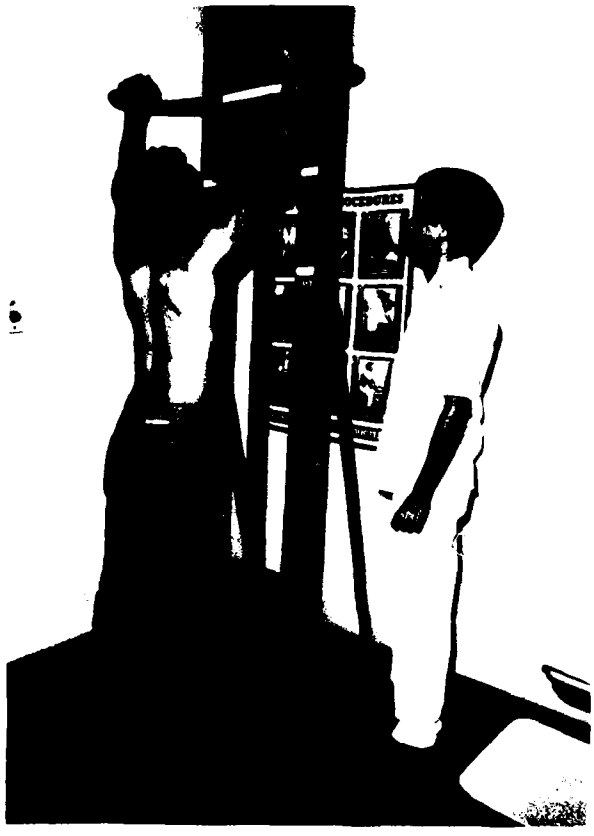
AFHRL Contact: 2d Lt Tracey Horton
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: Air Force physical job requirements are currently updated using subjective assessment procedures. AFHRL is presently conducting a comprehensive R&D program to develop a system to empirically derive and update physical demand requirements of enlisted specialties. Objectives of the present effort were twofold: to determine whether task-level data could be used to predict global physical demand ratings and whether these global ratings were comparable across eight specialties.

FY84 Milestones: Strength-and-stamina ratings were collected on 250 tasks across eight occupational specialties varying in physical demand. Several physical demand models were used to test the predictive efficiency of the global strength-and-stamina ratings. Regression analyses were used to determine the least complex model that adequately described the data. Additional statistical techniques were to identify those predictors which best fit the least complex model. Results indicated that the global ratings can be made comparable across specialties using one of the models tested. The predictors selected will be useful in identifying what task information should be included in a strength-and-stamina database. Presently, AFHRL is performing an in-house evaluation of the database and will extend the research to include 180 additional specialties.

Utilization: The measurement and practical issues that have been addressed in this R&D project will pave the way for the development of physical demand indices to be incorporated into the Person-Job-Match system. Refinement of the PJM algorithm to include physical demand factors is vital in light of the changing labor force and the continued Air Force goal for optimal assignment of individuals to jobs.

Benefits: An objective job measurement system incorporating physical demand indices would enable Air Force managers to optimize assignment algorithms and thus utilize personnel more effectively.



Physical Demand Indices Will Be Incorporated into the Person-Job-Match System

Title: FEASIBILITY OF COGNITIVE INFORMATION PROCESSING MODELS FOR BASIC SKILLS ASSESSMENT/ENHANCEMENT

AFHRL Contact: Sherrie P. Gott
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: The increase in complex technological systems that require highly specialized workers has brought new meaning to the concept of basic skills for the Air Force. These technological demands are questioning the usefulness of training in reading and computation skills for those individuals who lack specific technical knowledge. In response to modern day skill requirements, new methods are being used to investigate basic job skills: defined as the enabling core knowledge and knowledge-activating processes that are characteristic of proficient first-enlistment airmen, that is, those individuals who profit maximally from work experiences and show steady progression toward skilled performance.

FY84 Milestones: The first stage of a feasibility investigation examining the usefulness of a framework for measuring and training basic job skills has been completed. Questions of interest included the following. Is it feasible to apply information-processing task analysis techniques in a complex Air Force job environment? What can be learned by extending traditional behavioral task analysis to examine the information processing components that underlie apprenticeship proficiency? How does core knowledge contribute to this state of proficiency? Prior research concerned with understanding human expertise via expert-novice comparisons was used as the basis for an investigation into two occupations: electronics and jet engine mechanics.

The R&D yielded the following results. The application of new task analysis techniques, though labor intensive, was generally feasible and was informative in particularly important ways. Examining a restricted range of skilled performance provided hallmarks of the manner in which skills are acquired in the early stages of learning. Invaluable information was obtained at a suitable level of precision regarding the gaining of competence in technical skills. This level of precision will, in turn, help in establishing well-specified instructional goals that mirror uniformities in skill acquisition. The hallmarks include the presence of domain-specific conceptual knowledge about the task (e.g., knowledge of the operation of an electronic device), as well as a broader understanding of task demands that are common to multiple situations within an Air Force job environment (e.g., understanding the overall operation of the aircraft radar system). For the electronics occupation, skilled performers on a troubleshooting task tended to draw on a deeper understanding of how the system behaved as they conducted systematic and informed searches for malfunctions. Flexibility was maintained in the search process as alternate strategies were employed in response to feedback from the system. The profile of competence that emerged was that of a thinking, goal-directed yet adaptive problem solver.

Experiments were conducted to help explain performance differences as a function of three sets of variables: (a) understanding of basic electronic principles (e.g., concepts such as capacitor, diode, integrated circuit), (b) performing basic operations that comprise troubleshooting methods (e.g., processing logic gates in circuitry), and (c) understanding the systems that are objects of troubleshooting (e.g., the interrelationships among the components of a radar system). Skill-group differences were found in basic operations proficiency and system understanding but not with electronics understanding. These results suggest that, here, electronic principles are important only to the degree that the concepts are fundamental parts of the mental models that the troubleshooting technicians need in order to be efficient in given problem spaces. At a more general level, viewing skilled performance in this manner suggests that competent technical performance is not based on a deep knowledge of principles but rather occurs when the individual's intellectual skills match the technical demands of the task.

Utilization: This feasibility effort is part of a larger program to investigate the basic job skills related to apprenticeship proficiency in 125 Air Force occupations. The results will be used to develop task analysis methods that are diverse and comprehensive enough to capture the skill requirements of a broad range of occupational tasks. Information-processing analytic techniques will be particularly instrumental in

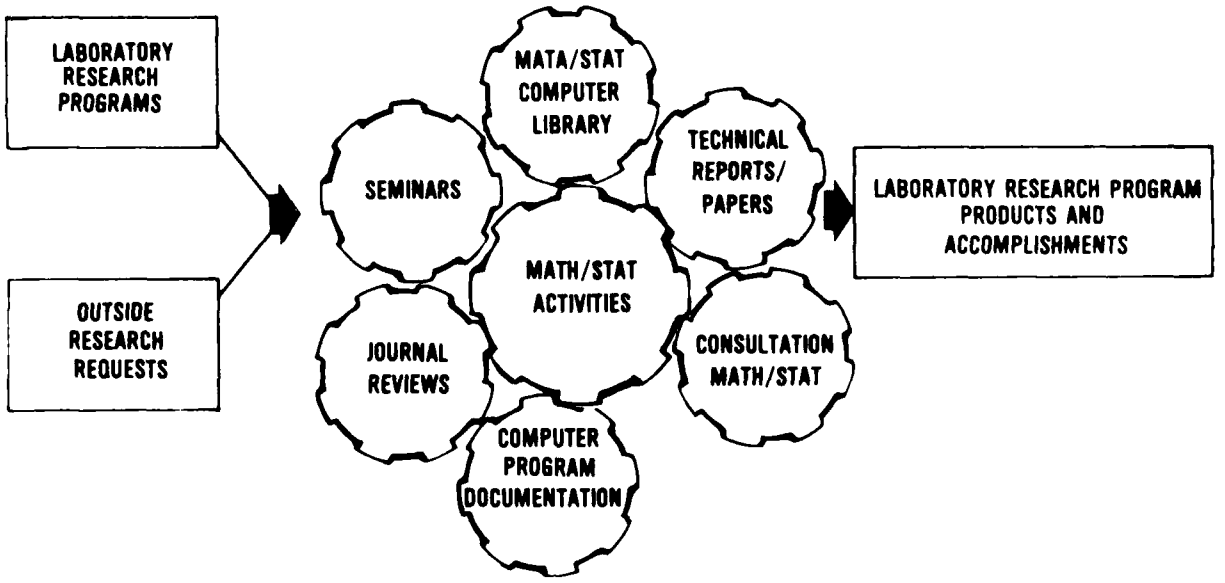
is underway to determine the effectiveness of the Air Force Officer Qualifying Test (AFOQT) for screening candidates for missile operations assignments.

FY84 Milestones: A research database was constructed containing training records and AFOQT scores for about 1,200 Minuteman students. Preliminary analyses were completed. Results indicated that a selector combining quantitative and verbal aptitudes would predict missileer success moderately well. Plans were developed to refine the selector by identifying more specialized ability areas related to missileer performance.

Utilization: The results have potential utility for establishing a second-stage AFOQT selector for missile duty. This selector would be above and beyond the AFOQT entry prerequisite for officer commissioning and would represent an extension of the application of the AFOQT to classification actions for non-rated jobs. Currently, the AFOQT is used for decisions into pilot and navigator specialties only.

Anticipated Benefits: An AFOQT selector for Minuteman duty is expected to reduce attrition of personnel from technical training. About $44,000 in training costs would be saved for each trainee who might otherwise be subject to attrition. Intangible benefits are expected, also. Assigning higher quality course graduates to missile launch sites would enhance nuclear surety and defensive capability.

Expected Completion Date: 1986



MATHEMATICAL/STATISTICAL TECHNIQUES FOR RESEARCH USE

FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Title: VALIDATION OF THE AIR FORCE OFFICER QUALIFYING TEST

AFHRL Contact: 1st Lt Thomas O. Arth
AFHRL/MOAO
Brooks AFB, TX 78235
Commercial (512) 536-2257
AUTOVON 240-2257

Description: The ability of the Air Force Officer Qualifying Test (AFOQT) to predict the success of officers in non-rated technical training courses (TTCs) was investigated. The predictive validity of the AFOQT has been well established for the rated specialties. However, validation work on non-rated specialties has been less extensive. This project takes a comprehensive approach for non-rated officers.

FY84 Milestones: Data were obtained on 9,029 officers who attended 37 technical training courses between 1979 and 1983. Correlations were computed between AFOQT composite scores and three criteria: numeric final school grade and two pass/fail variables. Further, regression analysis was accomplished to determine whether optimal weighting of the existing composites can enhance predictability of success in technical training courses.

Utilization: More effective personnel actions will be possible by using these results. Only officers with a high probability of success will be selected to attend non-rated technical training courses.

Anticipated Benefits: The results of this effort will provide the basis of an officer Person-Job-Match system. This system will enable officers to be optimally classified.

Expected Completion/Delivery: Feb 85

Title: REVISION OF ENGLISH LANGUAGE TESTS FOR USE IN OVERSEAS TESTING

AFHRL Contact: 1st Lt Thomas O. Arth
AFHRL/MOAO
Brooks AFB, TX 78235-5000
Commercial (512) 536-2257
AUTOVON 240-2257

Description: Currently, two tests are used to evaluate the English language proficiency of foreign nationals hired at overseas bases: the Basic English Language Tests (ELTs), composed of picture items, and the Intermediate English Language Tests composed of word items. These tests were last revised in 1965 and 1967, respectively, and there was little documentation regarding their validity. In addition, the Intermediate ELTs tested only reading ability, while the Basic ELTs tested reading, writing, speaking, and listening abilities.

FY84 Milestones: A revision has been accomplished by developing a new pool of items. These items were given to a sample of basic trainees to establish that knowledge of English alone is sufficient to respond correctly. The ELTs were then pretested on students at the Defense Language Institute to determine the validity of the revised instruments.

Utilization: This effort will result in an improved English language testing battery in that the intermediate tests will assess all four language areas. These tests will provide all overseas bases with instruments to assess the English language proficiency of job applicants and personnel considered for promotions.

Anticipated Benefits: Through the use of the revised English Language Tests, problems of test compromise and test validity will be resolved. By ensuring that job applicants can understand English, the missions of the overseas bases will be accomplished more efficiently through better communication between foreign nationals and their American counterparts.

Expected Completion/Delivery: Apr 85

Title: DEVELOPMENT OF AN APTITUDE SELECTOR FOR MISSILE COMBAT CREW DUTY

AFHRL Contact: Jacobina Skinner
AFHRL/MOAO
Brooks AFB, TX 78235-5000
Commercial (512) 536-2257
AUTOVON 240-2257

Description: Nuclear surety and national defense are compelling reasons for ensuring that combat crew positions for Minuteman ICBMs are staffed by high quality officers. At the request of the Strategic Air Command, research

4. Conduct in-depth analyses of conventional tests. The abilities measured by conventional paper-and-pencil tests are important predictors of future learning. However, these abilities might be measured more efficiently by the microcomputer. Microcomputer administration can also yield additional information, such as the speed of information processing, which cannot be easily obtained in the paper-and-pencil format. Conventional tests will be studied to determine how they should be reformatted for microcomputer administration in order to yield the maximum information related to individual differences in learning abilities.

FY84 Milestones: Based upon studies conducted to date, a framework for guiding research was developed and implemented. It is currently hypothesized that learning and performance behaviors are determined by the interactive effects of knowledge bases, processing capacity, and processing speed. Research during FY84 was centered on processing speed. During the year, it was demonstrated that processing speed can be measured reliably using microcomputer-administered tests; that there are related but distinguishable speed abilities for numerical, verbal, and reasoning processes; that measures of processing speed do not correlate highly with conventional paper-and pencil test measures; and that verbal processing speed measures contribute substantially to conventional ability measures in predicting verbal learning under high information flow conditions. This work will be extended to other domains in FY85, and research will be undertaken on measures of processing capacity.

Utilization: Basic research in personnel measurement is needed to rejuvenate a mature technology and to advance the state-of-the-art. Computerized cognitive tests hold promise as supplements to or replacements for conventional ability measures. They may measure some abilities more reliably and quickly than conventional paper-and-pencil tests, and they may measure useful abilities that cannot be measured at all by conventional tests.

Anticipated Benefits: With the continuously increasing power of cognitive theory and the rapid advances in electronic measurement devices, there is a high probability that Project LAMP will lead to significant improvements in our ability to accurately measure the large differences existing in individual learning and performance capabilities. For example, there already are indications that new measures of information processing speed (which could not be evaluated with paper-and-pencil tests) may improve our ability to predict individual performance in high information flow environments, such as low-altitude flying missions or command and control operations. Many performance deficiencies observed by commanders which are attributed to motivation or training problems are, in fact, selection and classification errors. Improved ability measures will be implemented in operational personnel selection and Person-Job-Match systems, thereby leading to better utilization of the Air Force's most expensive and important resource--people. The ultimate payoff will be realized in terms of reduced attrition rates in training and higher performance levels in job settings.

Expected Completion/Delivery: A 3-year research plan, for the Learning Abilities Measurement Program covering FY85-FY87, has been reviewed and approved by the Air Force Office of Scientific Research. During the 3 years, the program will produce periodic interim reports documenting research and development activities. It is anticipated that project activities will continue beyond FY87 into the 1990s.

Experimental Learning Laboratory

test. In recent years AFOQT test results have been used annually in a prescreening process to identify from 5,000 to 8,000 low ability applicants with a poor probability of success in officer training and in subsequent career assignments. Although the dollar savings associated with officer aptitude testing are indeterminant, each high risk applicant screened out represents a potential savings of $10,000 or more in commissioning training program costs alone.

Expected Completion Date: Dec 87

Title: LEARNING ABILITIES MEASUREMENT PROGRAM

AFHRL Contact: Raymond E. Christal
AFHRL/MOE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3570
AUTOVON 240-3570

Description: The Learning Abilities Measurement Program is exploring ways to identify and define the fundamental parameters of learning abilities. While the project is devoted to basic research, it is nevertheless goal oriented. The primary objective is to develop ability measures that can be used to forecast the rate at which individuals will acquire skills and knowledge. A second objective is to forecast ultimate levels of performance capability. Both of these criteria have been adopted because it has not been clearly established that individuals who are fastest at initial skill acquisition are necessarily those who reach the highest level of performance capability.

Project LAMP was initiated in recognition of the fact that there has been very little advancement in the state of the art in ability measurement during the past 25 years. The present availability of modestly priced microcomputers and other measurement devices creates the possibility of a major breakthrough. It appears that the first significant advance will be in the area of adaptive testing, which is being vigorously pursued by the Military Services. Adaptive testing promises to save testing time, yield better measurement at the extremes, and avoid the costs associated with frequent test replacement and norming necessitated by test compromise. Research currently in support of adaptive testing is targeted toward more efficient measurement of abilities tapped by present conventional paper-and-pencil tests. Project LAMP, on the other hand, is oriented toward the measurement of abilities currently not evaluated by conventional tests.

Four approaches have been adopted for this program as an initial attack on the problem:

1. Evaluate parameters of short-term learning curves as predictors of skill acquisition, decay, and reacquisition. Many of the conventional ability measures are primarily measures of knowledge levels. For example, the word knowledge test in the present Armed Services Vocational Aptitude Battery (ASVAB) measures how many words individuals have learned during their first 18 or 19 years of life experience. Such a test is also an indirect measure of learning rate, but it is an imperfect indicator due to differences in past learning opportunities and motivation. It is hypothesized that parameters extracted from short learning tasks administered under laboratory conditions will provide better prediction of subsequent learning behavior than can be obtained from the static knowledge measures represented in presently available conventional test batteries.

2. Identify new abilities. The availability of new measurement devices now makes possible the evaluation of abilities which cannot be easily tapped with paper-and-pencil tests. Initial research under Project LAMP will be centered on the measurement of memory abilities, automaticity of cognitive skills, and attentional resources.

3. Evaluate cognitive tasks as replacements for or additions to conventional paper-and-pencil tests. During the past two decades, cognitive psychologists have developed a large number of tasks that measure various aspects of information-processing skills. Most of these tasks are designed for administration by microcomputer or other electronic devices, and the emphasis has been on the measurement of response latencies as indicators of the speed and efficiency of mental functioning. Recently, large individual differences have been observed on such cognitive tasks.

Title: OFFICER TRAINING SCHOOL SELECTION ALGORITHM

AFHRL Contact: 2d Lt Martin E. Ellingsworth
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2932
AUTOVON 240-2932

Description: Efforts to establish an Officer Training School (OTS) selection algorithm have resulted in a computer-based weighted factors selection system. The system ranks applicants according to their expected performance in the Officer Training School program based on certain background variables concerning their cognitive abilities and profiles of their prior performance in either the civilian or military community. Predictor variables include Air Force Officer Qualifying Test scores, college grade point average and quality rating, extracurricular activities, recruiter evaluations, nonmilitary awards and achievements, time in service, Airman Performance Report information, and military awards and achievements. The algorithm will provide useful information to the Officer Training School selection boards and will serve as a check against the boards' initial rankings. Currently, the project is in the field-test stage of development.

FY84 Milestones: A field test of the algorithm was planned and approved for the May 1985 OTS selection boards. Questionnaires required for the field test were developed and validated through a pretest.

Utilization: The OTS algorithm will provide a consistency check on the initial board rankings. The unique set of information used in the algorithm, especially the school quality variable, will be used by the board in weighting an applicant's record, and the new scale being used will provide better discrimination between records.

Anticipated Benefits: The OTS selection algorithm and its accompanying rating scale will produce a superior rank-ordering of applicant records, with fewer ties than is possible with the current system; therefore, the best applicants will be selected for OTS according to stated Air Force policy. In time, there are possibilities for applying it to a Visible Individual Profile selection system and an applicant advisory system.

Expected Completion/Delivery: The field test is set for the May 1985 boards. Follow-up analysis and briefing will then occur, and with approval, final development and implementation of the system should be completed in FY86.

Title: DEVELOPMENT OF AN AIR FORCE OFFICER QUALIFYING TEST ITEM POOL

AFHRL Contact: Jacobina Skinner
AFHRL/MOAO
Brooks AFB, TX 78235
Commercial (512) 536-2257
AUTOVON 240-2257

Description: AFHRL is responsible for developing tests used in Air Force officer selection and classification decisions. R&D is conducted on a continuing basis to maintain and improve the Air Force Officer Qualifying Test (AFOQT), which is the principal mental ability test currently in use. A major project underway has the objective of developing a large pool of new test items for use in the next and subsequent forms of the AFOQT. Items are being written in ability areas tested by the current form (Form O). In addition, item types to assess new ability areas are being identified. Nearly 12,000 items will be written and tried out to determine their acceptability for use in operational tests.

FY84 Milestones: About 2,000 items in current ability areas were written, arranged in test booklets, and pretested on basic trainee samples at Lackland AFB. Test scoring and item analyses activities were started.

Utilization: Overproduction of items is necessary to have sufficient numbers for several planned activities. Items written in current ability areas will be used to produce the next version, Form P, in parallel versions. Surplus items will provide a ready source for future test development needs. Items in experimental ability areas will be evaluated carefully to determine if their addition to the AFOQT would improve its utility for officer selection and classification purposes.

Expected Benefits: The major product will be a more up-to-date AFOQT. Production of parallel versions will reduce the possibility for test compromise and will facilitate retesting of examinees with alternate forms. New item types have potential for increasing the validity of the

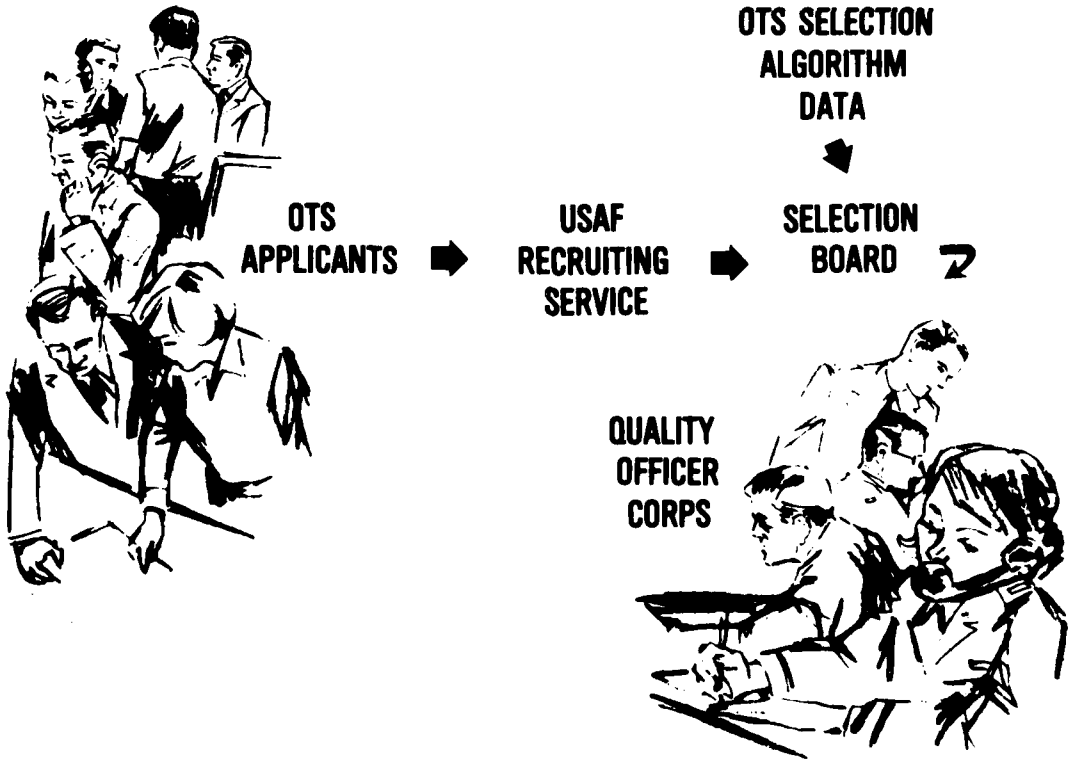
modifications will be made, where necessary, to adapt CODAP technology for changes in how data are collected, analyzed, and reported. Utility of the alternate and operational scales will be assessed through a series of task-based comparative analyses.

FY84 Milestones: Survey administration of the inventory booklets was conducted in the second quarter. Data were collected across 14 officer specialties within four career areas: Aircraft Maintenance/Munitions, Computer Systems, Manpower Management, and Security Police. Booklet return rates were 60% of the consensus survey sample. The development of a non-hierarchical cluster program was accomplished by the third quarter of this year. The addition of this program to the CODAP technology will enable occupational structure membership resulting from the use of different measurement scales to be directly compared. Data entry of the job inventory surveys was completed in the fourth quarter, and analysis on the computer systems and manpower management officer data sets was initiated.

Utilization: Officer occupational surveys will ultimately be developed using validated task-based job requirements. The technology developed will provide the means for establishing an empirical database for use by Air Force decision-makers regarding utilization of officers.

Anticipated Benefits: Successful development of a methodology to survey officer jobs accurately will enable the Air Force to bring officer training requirements in line with the demands of their jobs and provide the basis for a more definitive person-job match. Benefits to the operational commander will ensure that the requirements for any job can be reflected in the assignment process.

Expected Completion/Delivery: Comparative analysis of the alternate Part-of-Job scale with the operational Relative Time-Spent scale is 50% complete. A recommendation of a scale to USAFOMC will be made at the completion of the analyses in Aug 85. The analysis of the remaining task-based scales is 25% complete. The projected completion date is Mar 86.



AFHRL Conducts R&D to Improve Officer Selection

Basic Attributes Testing Station

Utilization: The R&D in these areas will be used by Air Training Command to improve the selection systems for pilot and navigator training. Additionally, the results of the work measuring combat mission effectiveness will be used to help develop a track selection system for Specialized Undergraduate Pilot Training (SUPT).

Anticipated Benefits: The implementation of the integrated pilot selection system will have a major impact on UPT attrition losses and quality. According to ATC projections, the integrated pilot selection system will save a minimum of $2,000,000 a year in attrition costs and enable instructor pilots to spend more time working with students who will graduate. This will improve the overall quality of UPT production while lowering its costs. The development of a track selection system for SUPT will ensure that students' skills and characteristics are best utilized in their operational assignments and that the maximum return is realized on post-UPT training.

Title: ENHANCEMENT OF OFFICER OCCUPATIONAL SURVEY TECHNOLOGY

AFHRL Contact: Louis Datko
AFHRL/MODJ
Brooks AFB, TX 78235
Commercial (512) 536-3648
AUTOVON 240-3648

Description: Occupational Survey/Comprehensive Occupational Data Analysis Programs (OS/CODAP) technologies, developed for Air Force enlisted specialties, have produced sizable benefits for the Air Force over the past two decades. The combination of OS/CODAP technologies has been instrumental in generating empirically validated job indices that have guided decisionmakers in the areas of classification, training requirements, and personnel assignments. However, application of these technologies to officer occupations has been questioned because of fundamental differences between officer and enlisted jobs. Enlisted jobs are easily differentiated along technical components of their work. Officers perform many administrative and managerial tasks common to jobs which differ technically. The managerial parts of jobs often overshadow the technical aspects. This commonality among officer jobs obscures distinctions necessary for accurately classifying and assigning personnel and tailoring training to each specialty. Previous research on measurement scales routinely used to collect task information on enlisted specialties has shown that these scales may not be appropriate for measuring managerial jobs -- specifically, those scales employing time as a measurement construct. Relative Time Spent and Task Learning Difficulty (the amount of time needed to learn to perform a task satisfactorily) are scales routinely used to measure enlisted occupations. Therefore, investigation of the application of OS technology to officer occupations is necessary to determine whether a direct transfer is feasible.

Proposed alternate scales are Part-of-Job, a modification of Hemphill's Part-of-Position scale, task complexity and officer training emphasis. Scales found to have higher utility in measuring officer occupations will be recommended to the USAF Occupational Measurement Center (USAFOMC) for operational use. In addition,

Four PORTA-BAT units have been designated for deployment to Europe to support a joint USAF and Euro-NATO pilot selection testing program. FORTRAN 77 was selected over other software for use on the PORTA-BAT units due to its compatibility with other software languages.

Utilization: The portable BAT systems will be used to support various R&D efforts, all designed to improve the selection and classification of rated officers. Near-term plans for the portable systems include testing of Air Force Academy pilot-qualified cadets; participants in the Euro-NATO Joint Jet Pilot Training Program at Sheppard AFB; F-15/16 operational pilots; and cooperative programs conducted in various NATO countries. These test data will then be evaluated to identify the significant predictors of flying performance which can be integrated into Air Force selection and classification procedures.

Anticipated Benefits: The portable BAT systems will greatly add to the capability of conducting aircrew R&D. Rather than having to transport people to the AFHRL facility for testing, the test systems will go to where the subjects are. This will reduce temporary duty costs, increase the number and type of subjects being tested, and speed the R&D process by channeling more data into analysis. Therefore, the aircrew selection and classification R&D project can proceed more quickly and address a wider range of important issues. These issues include a scientific means of predicting the probability of a) an individual completing pilot training, b) which person would be best suited for a bomber or cargo aircraft assignment, and c) which individual has the unique combination of perceptual-motor abilities and other attributes necessary to pilot an advanced fighter. An early determination of the best pilot-to-aircraft job match will increase safety, reduce attrition, save training costs, and ensure that the wing commanders have the most qualified personnel available to accomplish their mission.

Expected Delivery: The first portable BAT system arrived at the AFHRL in mid-October 1984, with the initial testing deployment scheduled for January 1985.

Title: SELECTION FOR PILOT/NAVIGATOR FLYING TRAINING

AFHRL Contact: Jeffrey Kantor
AFHRL/MOAA
Brooks AFB, TX 78235-5000
Commercial (512) 536-3222
AUTOVON 240-3222

Description: The increasing complexity of aircraft and the wide range of operational missions in which they are employed demand the highest possible performance from all aircrews. The goal of this R&D is to enhance the operational performance of the rated force by improving the way in which candidates for training are selected. Refining the initial selection process will result in less training attrition and a higher overall quality of graduates. One program which is well underway has added information about pilot candidates' psychomotor (hand-eye coordination) skills to normally used selection information and has resulted in major improvements in the accuracy of predicting who will pass or fail in Undergraduate Pilot Training (UPT). In a second R&D effort, candidates are being tested on their information processing abilities and several personality factors. This information will also be integrated into the selection decision. A parallel program will predict success in navigator training with an experimental Basic Navigator Battery. Additional programs are underway to obtain performance measures from pilots in operational squadrons to allow the very useful prediction of combat mission effectiveness.

FY84 Milestones: During this period, an integrated pilot selection system was developed and transferred to ATC for implementation. The system integrates Flight Screening Program (FSP) results, AFOQT scores, age and psychomotor test scores of the applicant. Validation testing of the information processing tests of the Basic Attributes Tests (BAT) was begun and portable test stations, called PORTA-BATs, were procured to administer the BAT away from the AFHRL Lackland testing facility. Finally, the Basic Navigator Battery (BNB) validatior study was concluded and documented in a technical report.

PORTA-BAT Units Are Shipped to Locations of Test Subjects

mized. Under a conscription system or the need for rapid mobilization to meet a perceived or actual threat, any attempt at malingering will be minimized.

Expected Completion/Delivery: Oct 85

Title: ADVANCED RESEARCH ON ADAPTIVE TESTING SYSTEMS

AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: When the same test is administered to every applicant, accuracy of measurement is limited to a restricted range about the mean. Without making a test exceedingly long, uniform accuracy across the measurement scale cannot be achieved. Computerized Adaptive Testing (CAT) is a name given to a series of techniques for presenting an appropriate subset of items from a very large item pool, in such a way as to increase the accuracy of measurement for the above- and below-average applicant. A goal-oriented series of efforts is underway to develop both prototype and operational item pools, as well as to advance the state of knowledge in the theoretical basis of adaptive testing.

FY84 Milestones: An item pool of 2,118 items was developed and pretested in the services recruit training centers.

Utilization: Adaptive testing will eventually be used in developing and norming Air Force operational aptitude tests and by the Air Force Recruiting Service and the Military Entrance Processing Command.

Anticipated Benefits: The future use of CAT in operational testing for the services will provide the opportunity for broader coverage in aptitude areas not previously measured, as well as minimize the problem of compromise which has occurred in the use of paper-and-pencil testing. In addition, it will improve the accuracy of testing and classification of individuals with exceptionally high or low abilities.

Expected Completion/Delivery: Oct 88

Title: PORTABLE COMPUTERIZED BASIC ATTRIBUTES TEST SYSTEM

AFHRL Contact: Capt Daniel Collins
AFHRL/MOET
Lackland AFB, TX 78236
Commercial (512) 671-2667
AUTOVON 473-2667

Description: Previous R&D has demonstrated the utility of measures of perceptual-motor abilities for the selection of personnel for pilot and navigator training and for technical training. Since the discontinuance of apparatus testing in the 1950s, interest in these measures has been revived, as computer-based testing techniques and the use of highly reliable solid-state components have become more widespread. These developments have eliminated most of the difficulties inherent in earlier electro-mechanical testing equipment. Solid-state electronics testing devices have been developed which administer two tests for psychomotor coordination. These devices have been used to collect data from a large sample of individuals slated for pilot training. These individuals are being tracked through training, and the relationships between the test scores and training performance determined.

Additionally, in response to user requirements for enhanced classification decision systems to support dual-track flying training, a computerized Basic Attributes Test (BAT) system has been developed. This testing system is designed to develop and implement a wide variety of human attributes tests, with particular emphasis on information processing consistent with aircrew workload and perceptual-motor requirements. Work is currently underway to develop a portable version of the BAT system to facilitate the collection of test information at varying locations. The portable BAT system will be totally automated and contained in a shipping case that will also open up to provide a standardized testing environment. The operation of the portable BAT systems will be highly user-friendly, enabling the units to be shipped to locations for data collection without requirements for specialized test administration facilities.

FY84 Milestones: Fifteen PORTA-BAT units have been ordered and are scheduled for delivery to the Lackland testing facility in October 1984.

FY84 Milestones. Approximately 3,000 items were written and tested on Air Force recruits.

Utilization: These versions will be used for measuring aptitudes of Army, Navy, Air Force, and Marine Corps applicants for enlistment after ASVAB Forms 11/12/13 become obsolete. The scores will be used for service selection and occupational classification.

Anticipated Benefits: The maintenance of the Armed Services operational test battery will allow the Air Force to continue to improve the selection and assignment of the best qualified recruits for entry into service and subsequent training. Although training attrition varies from a low of one percent to a high of 40 percent in a few highly specialized courses, the refinement of the selection and classification process provides one avenue to identify more accurately those individuals most likely to succeed in their basic military and technical training courses. Any reduction in attrition rates resulting from efforts to improve the selection of more highly qualified personnel represents cost savings in terms of recruiter replacement efforts, payment of service benefits, and permanent loss in return on overall investment by enlisting an individual not likely to complete the initial tour of duty.

Expected Completion/Delivery: Implementation, October 1987; Initial Operational Test and Evaluation, March 1988.

One Million Recruits Take the ASVAB Annually

Title: APPROPRIATENESS OF EXAMINEE TEST RESPONDING

AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: There are two general categories of inappropriate test-item responding that are of concern to the Armed Services Vocational Aptitude Battery (ASVAB) testing program. These are compromise (responding in which illicit knowledge of specific test items leads to scores indicating a higher-than-true ability) and malingering (responding in which deliberate failing of test items leads to scores indicating a lower-than-true ability). The first is of greatest concern under the current testing of volunteers; the second would be important were conscription to be resumed. A deliberate failure key is being developed, which will identify item response patterns indicative of intentional failure on the ASVAB as opposed to real failure. Also item response theory techniques based on probability strings will be applied to investigate several possible indices of inappropriate responding.

FY84 Milestones: A contract package was developed and negotiated.

Utilization: The Military Entrance Processing Command applies indices of compromise to item responses of every one of the approximately one million applicants tested each year. The indices determine requirements for retesting for individual applicants. Also, the indices can lead to investigation of recruiting practices in areas from which too many applicants are selected for retesting.

Anticipated Benefits: From an operational standpoint, the necessity for developing new forms out of cycle will be decreased since the temptation for recruiter-driven compromise as well as the likelihood of an applicant's successfully compromising the ASVAB will be mini-

ASVAB against job performance criteria from samples of civilian occupations in which many civilians are employed.

FY84 Milestones: Technical proposals from several industrial research organizations were received and evaluated.

Utilization: Validity information will be used by service recruiters and Military Entrance Processing Command personnel in promoting the ASVAB. School counselors will use these data in vocational exploration and guidance for students.

Anticipated Benefits: Successful completion of this project should enhance credibility of the DoD Student Testing Program and motivate students to take the ASVAB in schools, thereby increasing the efficiency of recruitment and entrance processing. Also, counselors and students would benefit from better validity information for occupational guidance.

Expected Completion/Delivery: Dec 86

Title: VALIDATION OF ARMED SERVICES VOCATIONAL APTITUDE BATTERY FOR AIR FORCE CLASSIFICATION

AFHRL Contact: James Wilbourn
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Air Force uses the Armed Services Vocational Aptitude Battery (ASVAB) for classification of applicants. The present four aptitude composites (Mechanical, Administrative, General, and Electronics) are validated against technical course final grades for every set of ASVABs implemented by the Armed Services. In addition, course-specific composites will be formed for over 200 technical training courses.

FY84 Milestones: An interim report on the validity of ASVAB 8, 9, and 10 aptitude indexes with final school grades was published in July.

Utilization: Information from this effort will be fed into an update of the Person-Job-Match system of the Air Force manpower assignment system. The Air Force Recruiting Service uses the Procurement Management Information System (PROMIS) portion of the Person-Job-Match system to offer job specialties to qualified applicants. PROMIS selects the offered jobs based in part upon the prediction of the applicant's successful completion of the technical training course for the specialty.

Anticipated Benefits: Validation of operational tests provides the opportunity to assess the actual utility of these measures to predict training performance. This information provides the mechanism to identify areas requiring revision in the classification process. Any revision to ensure that individuals assigned to jobs can perform more effectively improves the operational capability of those units to which individuals are assigned. In the training area, requisites for successful performance in specific courses can be identified by the validation process.

Expected Completion/Delivery: Jul 85

Title: DEVELOPMENT OF FOLLOW-ON FORMS OF THE ARMED SERVICES VOCATIONAL APTITUDE BATTERY

AFHRL Contact: Maj John Welsh
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: The Armed Services Vocational Aptitude Battery (ASVAB) is the enlisted selection and classification test used by the Army, Navy, Marines, Air Force, and Coast Guard. The ASVAB test forms are changed on a regular schedule to keep items current and to reduce compromise. Six ASVAB test versions are being developed to follow ASVAB versions 11a, 11b, 12a, 12b, 13a, and 13b. The new versions will be consistent with the old versions; only the specific wording in the items will change. The ASVAB development consists of three phases: item writing and tryout, development of over-length subtests and development of six forms, plus an Initial Operational Test and Evaluation. Finally, after implementation, the Initial Operational Test and Evaluation will assess the appropriateness of operational conversion tables.

Title: ANALYSIS OF MANPOWER PROJECTION OF SKILL REQUIREMENTS

AFHRL Contact: Larry T. Looper
AFHRL/MOMD
Brooks AFB, TX 78235-5000
Commercial (512) 536-2912
AUTOVON 240-2912

Description: This project was undertaken at the request of the Directorate of Manpower and Organization, Air Force, through Request for Personnel Research (RPR) 82-03. Examination was made of the existing process by which the personnel and training community anticipates projected manpower requirements derived from the Air Force's portion of the Five Year Defense Plan. The needs of the personnel and training community for manpower projections according to scope, time, and level of detail were surveyed. The Skills Projection Model (SPM), which had not been used for several years, was analyzed and exercised to determine its utility as a projection tool. The analysis of the SPM concluded that the model does not offer a viable future means for projecting manpower requirements. An extensive and detailed analysis of the growth and variability of manpower authorizations by occupational grouping and the projected authorizations by major command and program element was conducted. Trends were noted in the occupational authorizations and considerable variation was noted across program element authorizations included in the Force and Financial Plan. A comparative analysis of manpower projection procedures used by other DoD, governmental, and private organizations was conducted with suggestions drawn for Air Force use. The research culminated in the presentation of four alternative procedures for projecting enlisted manpower requirements and some suggested implementation guidelines.

FY84 Milestones: The SPM and manpower authorizations were evaluated in FY84. The work was completed with receipt of the final report and delivery of the final briefing to the requirement managers.

Utilization: This R&D has provided an in-depth examination of the skill projection process and has provided alternatives to the current process by which the personnel and training staff anticipate how Major Commands and Separate Operating Agencies will distribute allocated manpower. The manpower community will use the results of this evaluation of the skill projection process to assist them in designing more effective manpower systems. The knowledge of patterns of force authorizations and the information needs and uses to which the personnel and training community puts skill projection information will serve as definitive guides in future system design.

Anticipated Benefits: With the implementation of the procedures suggested in this R&D, the personnel and training staff will be able to make more responsive decisions based on knowledge of how Major Commands and Separate Operating Agencies might distribute their allocated manpower. Being able to anticipate more quickly and accurately how this allocated manpower will be distributed across units and career specialties will permit the personnel and training staff to react more effectively to manpower program changes such as introduction of new weapon systems or other technological changes which affect recruiting, training, and retention requirements. Since the personnel and training systems will operate more responsively, operating units will benefit by being able to fill vacancies more quickly with better-trained personnel.

Title: CIVILIAN OCCUPATIONAL VALIDATION OF ARMED SERVICES VOCATIONAL APTITUDE BATTERY

AFHRL Contact: Malcolm Ree
AFHRL/MOAE
Brooks AFB, TX 78235-5000
Commercial (512) 536-3256
AUTOVON 240-3256

Description: In the DoD Student Testing Program, secondary and postsecondary institutions are offered administration and score reporting of the Armed Services Vocational Aptitude Battery (ASVAB) for use in guidance and counseling of students. The validity of ASVAB measures for civilian jobs is currently based on military service data and validity generalization techniques. Direct empirical data are needed on civilian occupations to verify ASVAB validity and provide more specific counseling information. The goal of this effort is to validate

examining requirements in high-tech workplaces where demands on airmen's mental operations are especially heavy. The results for the electronics occupation will also provide the basis for an experimental intelligent computer-assisted instructional program for improving troubleshooting skills.

Benefits: Greater precision in analyzing workplace tasks is essential so that training reflects the specialized requirements of the high-tech workplace while avoiding the waste of training skills that will go unused once the airman is on the job. Task analysis based on models of information processing offers more precise input to training so that what the high-tech worker is taught is what is really needed. Similarly, analysis of the information processing components of skilled technical performance can reveal new "layers of commonalities" shared by complex Air Force occupations. The greater this common base (that is, the better the understanding of how the jobs are alike), the greater the opportunities (a) to streamline training across occupations, (b) to ease the movement of airmen across jobs, and (c) to train skills that are transferrable and thus of greatest utility in the technologically dynamic workplaces of the Air Force.

AFHRL Developed Procedures for Projecting
Enlisted Manpower Requirements

FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Title: DEVELOPMENT, ACQUISITION, TESTING, AND MAINTENANCE OF MATHEMATICAL/STATISTICAL SOFTWARE

AFHRL Contact: C. Deene Gott
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2912
AUTOVON 240-2912

Description: This effort encompasses the evaluation, procurement, development, implementation of new (and the maintenance of existing) mathematical/statistical methodologies and/or associated software. A mathematical/statistical computer program library consisting of approximately 50 operational packages has been established for users of the AFHRL Sperry 1100/81 computer system. A standard documentation format for this software has been designed which contains information such as purpose of each program, restrictions and limitations, control and input data specifications, description . . interpretation of output, program messages, references, computational formulas, sample runs, and personnel to contact for assistance.

FY84 Milestones: The most recent versions of the following mathematical/statistical packages were implemented: Statistical Package for the Social Sciences, Biomedical Computer Programs, and International Mathematical and Statistical Library. Also, the following programs were added to the library: ALSCAL-F for multidimensional scaling, LGP for generalized goal programming, RANGEX for correlation correction involving restriction of range, CLUSTAR for hierarchical clustering, MAPCLUS for nonhierarchical clustering, TSP for econometric estimation and forecasting, and SLAM II for general purpose simulation.

Utilization: This effort centers on providing mathematical/statistical methodological and computational support to all research areas in the AFHRL Manpower and Personnel Division. The most recent additions to the computer program library, all of which provide task scientists with new analytical capabilities and/or increased computational speed, are being used in the following research projects; performance measurement, basic skills, learning laboratory, aptitude requirements, retention, forecasting, Person Job Match, Armed Services Vocational Aptitude Battery, officer occupational survey technology, profile analysis, Weighted Airman Promotion System, rated selection, and Training Decisions System.

Anticipated Benefits: The extensive software contained within the mathematical/statistical library makes available the latest techniques for use in AFHRL research so that analysis of data is accomplished with state-of-the-art methodologies. The ready availability of the library avoids delays for computer program development and enables task scientists to meet schedules and milestones. Similar benefits also extend to other agencies and outside organizations (e.g., Occupational Measurement Center) who request computer software and/or consultation on an average of three times per month. Such requests normally involve rapid response analyses to operational problems and issues of concern to the manpower and training communities.

Expected Completion/Delivery: The goal of this program area is to develop and/or implement new mathematical/statistical methodologies and associated software and to maintain existing software on line. The first part of this goal involves evaluating, procuring, writing, developing, testing, modifying, implementing, documenting, and/or disseminating new scientific programming packages. The delivery dates of these products are determined by AFHRL research requirements. The maintenance part includes updating all associated documentation and keeping existing programs in an operationally ready status. There is a continual requirement for this work.

Title: ONGOING DEVELOPMENT OF THE COMPREHENSIVE OCCUPATIONAL DATA ANALYSIS PROGRAMS

AFHRL Contact: William J. Phalen
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2932
AUTOVON 240-2932

Description: The Comprehensive Occupational Data Analysis Programs (CODAP) is a package of computer programs used to input, process, organize, and report occupational data from job inventories. The package was developed by AFHRL in the early 1960s and contains over 60 FORTRAN V computer programs. The current AFHRL package has the capability of processing 20,000 cases, 1,700 task ratings per case, and 1,000 items of background information per case. Hierarchical clustering can be performed on up to 7,000 cases. The entire system contains eight basic types of programs: (a) data preparation and file setup programs, (b) data quality control programs, (c) sample identification and selection programs, (d) individual and summary report programs, (e) individual and group comparison programs, (f) task factor and task module programs, (g) cluster analysis programs, and (h) standard statistical analysis programs. Because the data that are input to the package are gathered at the worker-task level, the system provides a base of information that may be utilized in many ways to address a variety of predefined and sometimes unanticipated management questions.

The technical support during the past year has been aimed at (a) continued enhancement of a methodology for restructuring and summarizing survey data for higher-level management in increasingly diverse functional areas, (b) upgrading of the utility and running efficiency of several major CODAP programs to meet the needs of AFHRL and the Air Force Occupational Measurement Center (USAFOMC), (c) significant improvements in program documentation and software maintainability, and (d) development of a runstream of existing programs to give the system a nonhierarchical clustering capability, which permits the clustering of an indefinitely large number of cases or enhances the interpretability of hierarchical clustering solutions.

FY84 Milestones: A nonhierarchical clustering capability was developed in the current CODAP system. The redesign of the CODAP system neared the half-way point with the completion of the following efforts: standardization of files and programming code, adoption of ASCII FORTRAN, reduction in number of required programs, expansion of documentation for existing programs, reduction of program running times, expansion of data-handling capabilities, and revision of hardcopy output formats.

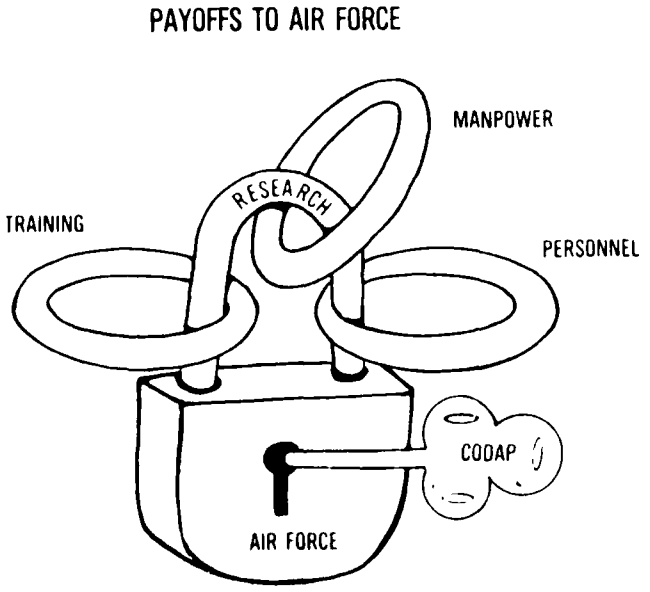
Utilization: In addition to its ongoing operational uses in updating and evaluating the Air Force officer and enlisted classification structures and in developing and validating the content of training programs, CODAP is now being employed to develop a scientifically sound basis for realigning entry-level aptitude requirements across Air Force career fields and to address questions about the requirements of jobs, such as strength and stamina. All of these uses will be integrated with the initial personnel selection process and eventually with the Person-Job-Match model. The processed data by the Comprehensive Occupational by Data Analysis Programs are the major component in the development of the Occupational Research Data Bank. Currently, the technology is also being integrated with the Air Force Specialty Knowledge Test development program as the most effective means of assuring the job-relatedness of test content. The successful implementation of task analysis procedures in Instructional Systems Development will depend heavily on the data and analytic techniques available with the CODAP programs.

Existing and future software are essential components of several new, high-priority research efforts, such as the development of (a) performance measurement procedures and criteria, (b) an officer occupational survey technology, (c) a Training Decisions System, (d) an Advanced On-the-Job Training System, (e) a Task Identification and Evaluation System, and (f) an integrated system to assess and enhance basic job skills. During the past year, the technology has been transferred to the U.S. Postal Service and the Minnesota Department of Employee Relations.

Anticipated Benefits: CODAP continues to be instrumental in AFHRL and USAFOMC research aimed

at providing Air Force managers with increasingly precise tools (a) for establishing input talent needs for each Air Force Specialty, (b) for using personnel effectively, (c) for delivering appropriately targeted training, (d) for ensuring fairness in assignment and promotion policies, and (e) for producing a readily accessible pool of pertinent Air Force occupational information. In the public sector, CODAP continues to benefit Federal agencies and state and county governments by providing an ideal vehicle for validating their selection and promotion testing procedures in accordance with the guidelines specified by the U.S. Equal Employment Opportunity Commission and by providing invaluable input to the development of job evaluation, performance measurement, job classification, and training development criteria and procedures.

Expected Completion/Delivery: An operational version of the system is currently available. However, the multiplicity of CODAP users and the wide variety of applications will continue to require constant updating and expansion of the CODAP system to meet current and anticipated demands for new capabilities.



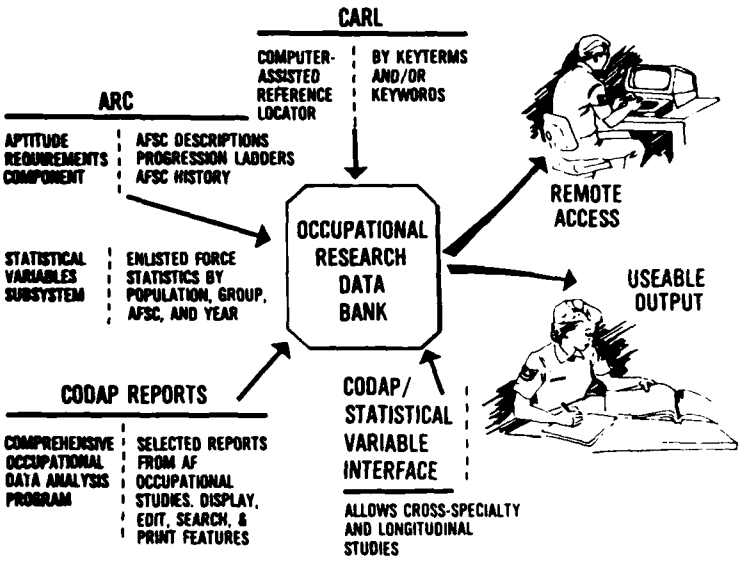
Title: DEVELOPMENT OF AN AIR FORCE OCCUPATIONAL RESEARCH DATA BANK

AFHRL Contact: Larry K. Whitehead
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2913
AUTOVON 240-2913

Description: Efforts to establish an Air Force Occupational Research Data Bank (ORDB) have resulted in a computer-based system that provides immediate access to a wide variety of occupational information about Air Force job specialties and the people who perform duty in them. The major subsystems in the ORDB provide reference for occupational studies and other documents, Air Force Specialty Code descriptions, occupational aptitude requirements data, statistical information on the enlisted force, and selected Comprehensive Occupational Data Analysis Programs reports. In addition, longitudinal analysis and cross-occupational analysis capabilities are available. All of these subsystems are operational, and work is being directed to interface the ORDB with the Statistical Package for the Social Sciences for enhanced statistical reports.

FY84 Milestones: The following changes were made to the ORDB: the key term list option was added, the AFSC change history was expanded to 1965-1984, an aptitude information section was modified, a new version of the Statistics section was tested and loaded, the "HELP" routine was added, and CY1982 data were loaded. The documentation was improved by revising the User Manual and making it available by on-line request and by updating the Procedural Guide.

Utilization: The ORDB has been designed to support the R&D thrusts of AFHRL. It is a centralized inquiry system for researchers and managers to obtain quick-response answers for questions regarding the characteristics of specialties, such as mean test scores, ethnic mix, and geographical distribution. Without the ORDB, such questions may take weeks to answer, and other background research would be much more cumbersome and time-consuming. Cross-comparisons of specialties with respect to their characteristics are readily obtainable and should lead to more effective selection of occupations for special studies. Personnel and



training data and CODAP reports are available for calendar years 1978 through 1982.

Anticipated Benefit: The ORDB will streamline background research and literature review by automating this phase of R&D. In addition, the aggregate statistics for Air Force personnel will be readily accessible by commanders and will provide demographic, training, and other force descriptive data from a historical and operational viewpoint. These statistics should allow the commanders to make more informed decisions. Furthermore, the system will support many of the high priority ongoing projects at AFHRL. A centralized and extensive database on occupational data will expedite future research and will give added information for use in Air Force policymaking.

Expected Completion/Delivery: At present, all the prototype systems within the ORDB are operational, but the data are not current. By mid-1985 this system will be in the maintenance stage with readily accessible source documents and up-to-date information for 1979-1983.

Title: ASSESSMENT OF PHYSICAL STRENGTH-AND-STAMINA REQUIREMENTS IN AIR FORCE SPECIALTIES

AFHRL Contact: 2d Lt Tracey Horton
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: Each Air Force enlisted specialty is presumed to differ in the nature and extent of physical capabilities required for successful job performance. In a variety of specialties, effective performance requires above average physical strength-and-stamina from incumbents. Little systematic R&D has previously been done to support definitive assignment criteria to ensure that personnel capabilities meet job requirements. A comprehensive two-stage assessment of the physical occupational requirements in 188 enlisted specialties has now been completed. Approximately 16,000 supervisors worldwide have rated more than 67,000 occupational tasks for purposes of identifying, defining, and quantifying physical demand requirements within specialties. Results from the first stage of the assessment have shown that supervisors can reliably identify and rate physically demanding tasks and thereby provide the empirical base for developing specialty-specific physical demand indices. More specifically, this research has shown that an occupational survey approach is possible in measuring the strength-and-stamina requirements of Air Force jobs.

Ongoing and future R&D activities include the formulation of regression models to establish the predictive accuracy of specific task parameters and to determine the extent to which physical demand characteristics are comparable across specialties. A follow-on study will validate the occupational ratings using actual field measurements.

FY84 Milestones: FY84 milestones involved comparisons of data results from several research efforts including the current AFHRL

What are the physical demands of Air Force jobs?

strength-and-stamina project. Preliminary findings indicate that the Survey Methodology used in AFHRL research is the most economical indicator of physical job requirements.

Utilization: Physical demand indices will ultimately be incorporated with the Person-Job-Match system as additional factors to be considered for the optimal assignment of individuals to jobs. Further refinement of the algorithm with physical demand factors is especially important in view of current accession trends, namely, declining numbers of qualified male enlistees and the concomitant increase in the proportion of females serving in the Air Force.

Anticipated Benefits: Optimally matching the person to the job offers dual benefits. The Air Force benefits when the best person fills the job and is thus able to perform it well. The worker benefits if the assignment is objectively derived, thus enhancing the opportunity to succeed. The questions providing the impetus for this research have not been "What jobs can women do in the Air Force?" or "Where can their presence be tolerated?" but rather "What are the physical demands of Air Force jobs?" and "How can those demands be validly measured and subsequently linked to performance tests to determine eligibility of both male and female recruits?"

Expected Completion/Delivery: Oct 91

Title: DEVELOPMENT OF AN INTEGRATED SYSTEM TO ASSESS AND ENHANCE BASIC JOB SKILLS

AFHRL Contact: Sherrie P. Gott
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: The ever-growing technological sophistication of Air Force equipment and systems and the associated need for airmen to learn faster once on the job have triggered this investigation of basic job skills related to first-term proficiency. Basic job skills are defined as the core knowledge and ways of using that knowledge that enable accelerated skill progression and on-the-job learning in the first enlistment. Plans have been formulated to develop and apply an integrated assessment and enhancement system that will (a) measure and validate basic job skill requirements, (b) assess enlisted personnel on those skills, and (c) provide design specifications for training in deficient areas. In addition, a preliminary feasibility study has been accomplished to examine the applicability of new task analysis techniques for this Air Force inquiry. The new methods allow for the measurement of the kinds of information processing skills that are demanded in high-tech workplaces. Plans are also in progress for the development and delivery of intelligent computer-assisted instruction directed toward improving the troubleshooting skills of apprentice electronic technicians who maintain complex avionics systems. Products that will result from this effort include methods to analyze job tasks, tests to measure airman basic job skill proficiencies, and a blueprint for developing training to address skill deficiencies.

FY84 Milestones: Technical research plans were finalized and forwarded for competitive procurement action.

Utilization: This effort is part of a comprehensive R&D program undertaken by AFHRL to improve classification, assignment, and training systems by careful examination of actual workplace demands. More specifically, classification and assignment procedures can be made more precise with information about the core knowledge and thinking processes that enable accelerated first termer growth. In addition, this same information provides the basis for improving technical and on-the-job training by ensuring that actual workplace demands directly influence training content and that new instructional approaches are adopted where necessary to handle skills of the "high-tech workplace." After an advanced development phase, the job-oriented, basic skills training program will be proposed to replace the existing basic skills programs that are not functionally oriented and to supplement technical and on-the-job training where appropriate.

Anticipated Benefits: A system that more precisely captures the knowledge and thinking skills important to apprenticeship proficiency will benefit both Air Force training and selection/classification procedures and will thereby enable airmen to arrive at their initial assignments better equipped to acquire functional skills rapidly. Upon arrival at their first assignment, airmen will progress through on-the-job training more easily since they will possess those knowledges and skills which enable them to acquire functional skills rapidly. The ultimate benefit will be airmen who become fully competent in an operational unit more rapidly. From a training standpoint, more effective utilization of training dollars will be assured by emphasizing the acquisition of skills that are basic to sustained success in high tech workplaces.

Expected completion/delivery: Jan 90

Title: ENLISTED ASSIGNMENT/REASSIGNMENT RESEARCH

AFHRL Contact: Manuel Pina, Jr.
AFHRL/MOMP
Brooks AFB, TX 78235-5000
Commercial (512) 536-2442
AUTOVON 240-2442

Description: The object of this effort is to develop an assignment technology that will be used by the Air Force in the Person-Job-Match (PJM) areas. A Request for Personnel Research has been initiated by the Recruiting Service, the Air Training Command, and the Air Force Manpower and Personnel Center. The request is for the enhancement of the PJM technology for use in the Procurement Management Information System (PROMIS) and the Processing and Classification of Enlistees (PACE) system. A 5-year research effort started in December 1984 will address the requested personnel research. The PROMIS portion of the effort will include:

1. Consultation in the reprogramming of the selection and classification algorithm for the new Manpower and Personnel Center computer system.

2. Improvement of the present PROMIS by including the Vocational Interest Career Examination (VOICE) and Armed Services Vocational Aptitude Battery (ASVAB) subtest scores as selection and classification variables.

3. Development of additional classification methodologies (PROMIS II).

The PACE portion of the effort will include:

1. Development of alternative classification algorithms.

2. Comparison of the current and alternative classification algorithms.

FY84 Milestones: Request for Personnel Research 85-01, Enhancement of Person-Job-Match (PJM)

FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Technology, which directs this work was validated. Initial discussions were held on the implementation of VOICE and ASVAB subtest scores and on reprogramming the PROMIS selection and classification algorithm.

Utilization: This R&D effort will expand the PJM technology presently being used by the Air Force. The enhanced technology will enable PROMIS to improve the preenlistment selection and classification of nonprior service enlisted personnel and will enable PACE to improve the postenlistment classification of nonprior service enlisted personnel.

Anticipated Benefits: Improvement in the PROMIS and PACE systems will ensure that enlisted personnel will be selected and assigned in an optimal fashion. While both systems will be designed to meet Air Force requirements and specific policy goals beneficial to the Air Force, an improved match between an individual's desires, abilities, and the requirements of the job will optimize the utilization of recruit talent, increase the probability of training success at technical training centers, and increase individual job satisfaction and on-the-job productivity. Actual training costs can be minimized by assigning personnel with high probability of success on the job to Air Force Specialties (AFSs) with high training costs and personnel with low probability of success to AFSs with low training costs. With the refinement of the PJM methodologies, decreased attrition, higher morale, and better utilization of human resources will be achieved. Technical training commanders will benefit by receiving students who possess the required qualifications and desired motivation to complete their training course curricula successfully. Commanders of operational units will benefit by receiving personnel with the required abilities and desire to perform their jobs.

Expected Completion/Delivery: PACE - Dec 88, PROMIS - Dec 90

AFHRL Conducts R&D to Encourage Retention

Title: NATIONAL LABOR MARKET RESEARCH PROGRAM: RETENTION ANALYSIS

AFHRL Contact: John Taylor
AFHRL/MOMD
Brooks AFB, TX 78235-5000
Commercial (512) 536-3047
AUTOVON 240-3047

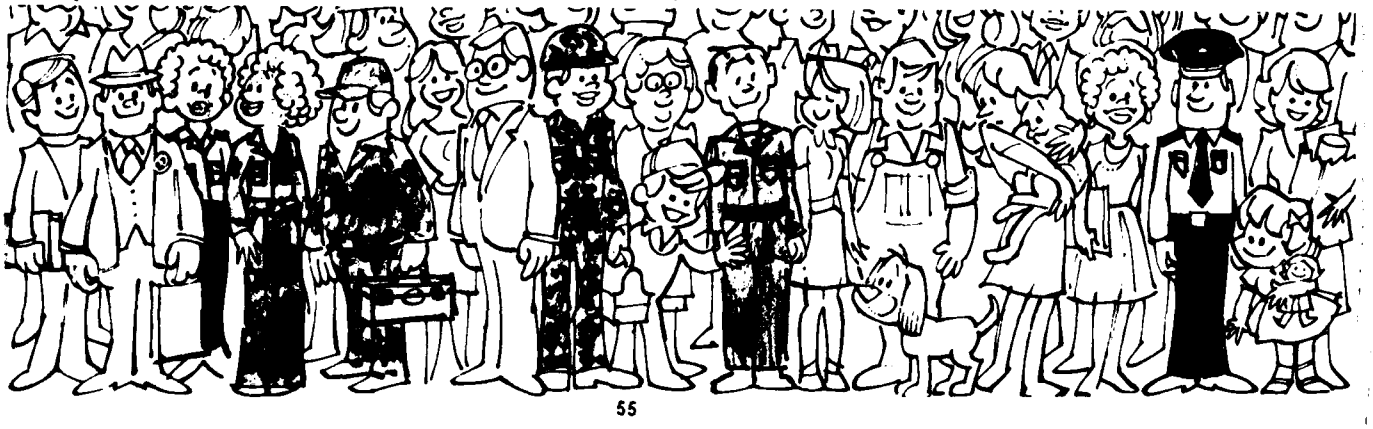
Description: During the past year, three research efforts were conducted under the AFHRL multiyear National Labor Market Research Program. This program is quantitatively describing the relationship between the national labor economy and the ability of the Air Force to attract and retain qualified and experienced members. The first effort estimated retention equations across all Air Force Specialties for the first, second, and career retention decision points. Variables used in this analysis included wages, bonuses, and retirement pay; force policies such as use of a draft; quality measures such as high school graduation; and other demographic data affecting pay, such as marital and dependent status. The second effort examined what is known as the "leading retention rate indicator" hypothesis. This hypothesis asserts that the retention decision of the overall enlisted force or large segments of it could be predicted by other groups (e.g., those with skills readily marketable in the civilian economy) or the movement of other economic trends. The third effort consisted of the acquisition of the Air Force Retention Analysis Utility Package (AFRAUP), a computer software routine which incorporates the results of the retention estimation effort and permits retention rate and force distribution analyses.

FY84 Milestones: The Historical Airman Database (HAD) was updated to aid development of the retention rate estimation equations by job specialty and reenlistment term. AFRAUP software was installed on the IBM-PC to facilitate use of the estimation equations. A draft technical paper documenting the development of the estimation equations has been prepared. Also, the idea of a "leading retention rate indicator" was explored.

Utilization: The results of research efforts pursued under the National Labor Market Research Program will provide Air Staff offices with the quantitative means for justifying various economic programs to higher Air Force levels, to the Office of the Secretary of Defense, and to Congress. Also, the acquisition of the AFRAUP software will permit rapid exploration of the impact of various economic factors on the retention of enlisted personnel. Although insufficient evidence surfaced to substantiate the "leading retention rate indicator" hypothesis, the research did demonstrate that monthly retention rates could be modeled using traditional time series techniques.

Anticipated Benefits: This effort will permit Air Force personnel planners to understand the quantitative effect on retention caused by changes in such factors as Air Force compensation, force management policies, individual demographics, and civilian job opportunities and pay. Information of this type will enable the Air Force to make more informed compensation and retention policy decisions and, therefore, compete more effectively in the national labor market to retain those individuals necessary to carry out the Air Force mission. Operational Air Force commanders should see the direct impact of more effective use of economic resources through improved retention resulting in a more experienced force.

Expected Completion/Delivery: Final report on the Enlisted Manpower Supply effort should be published by May 85.



FORCE ACQUISITION AND DISTRIBUTION SYSTEM

Title: NATIONAL MANPOWER INVENTORY

AFHRL Contact: Larry T. Looper
AFHRL/MOMD
Brooks AFB, TX 78235-5000
Commercial (512) 536-2912
AUTOVON 240-2912

Description: The National Manpower Inventory (NMI) is a Tri-Service and DoD joint project (with DoD funding) to produce an inventory of military-related skills in the civilian population and to provide a capability to project that inventory under varying scenarios. AFHRL is a member of the NMI Working Group chaired by the Army Research Institute which is charged to oversee the project. To date there have been three component subprojects. The first of these subprojects presented a rationale for using occupation (career specialty) as a proxy for a more detailed description of what a person could do (skill). This subproject also discussed the concept of criticality of military occupations and developed lists of critical jobs under various definitions of criticality. A second subproject conducted by the Census Bureau was the construction of two distributions of the 1980 Decennial Census: (a) a detailed geographical distribution which has highly aggregated occupational and demographic data and (b) a second distribution with detailed occupational and demographic information within a highly aggregated geographical breakout. The third subproject undertaken by the Center for Naval Analysis (CNA) is currently in progress and is designed to integrate the previous two components, along with DoD occupational crosswalks which relate military and civilian jobs and actually build an operational model to measure and project these civilian population skills.

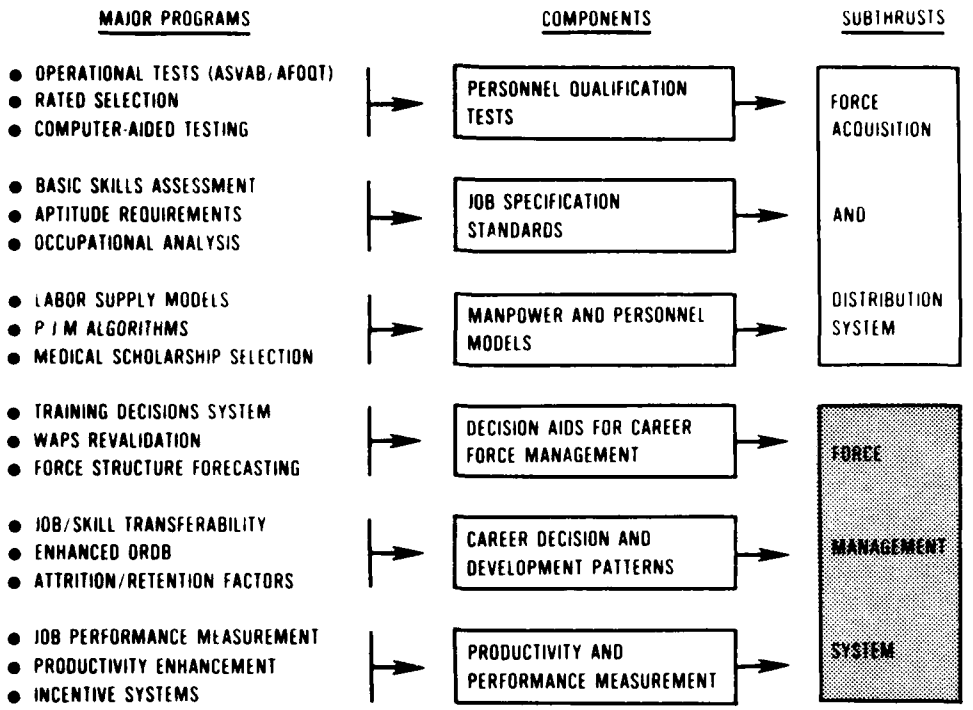
FY84 Milestones: Reports were received on two subprojects. The criticality study was delivered in FY84 along with the CNA interim report.

Utilization: The detailed occupational and demographic data from this research will be used by the recruiting commands of all the Services to make resource (e.g., recruiters, advertising) allocation decisions. Such information will be useful to mobilization planners who require information on where and what kinds of people would be available for mobilization.

Anticipated Benefits: Products from this research and the implementation of an ongoing process for collecting, formatting, and projecting such data will provide a valuable tool for manpower, personnel, and training planners across all the individual services and Office of Assistant Secretary of Defense (MI&L). Detailed information on the number and experience levels of the civilian population with military-related skills will be invaluable in a period of mobilization and in peacetime. The recruiting commands of the Services could use the information to make more effective placement of recruiters and more efficient use of advertising funds. Potentially, under either mobilization or peacetime scenarios, military trainers could benefit from such a data system by being able to tailor training to the civilian experience of trainees and thus shorten training time or provide an enlarged training curriculum. Operational units in any Military Service should see benefits by having individuals who possess knowledge and have learned more skills than in the past and, under rapid buildup conditions, commanders would be able to fill their unit vacancies more quickly.

Expected Completion/Delivery: Sep 85

MANPOWER AND FORCE MANAGEMENT THRUST



FORCE MANAGEMENT SYSTEM

Title: SITUATIONAL CONSTRAINTS ON PERFORMANCE AND OTHER WORK OUTCOMES

AFHRL Contact: Thomas W. Watson
AFHRL/MOD
Brooks AFB, TX 78235-5000
Commercial (512) 536-2257
AUTOVON 240-2257

Description: The impact of situational constraints on performance and other work outcomes, such as satisfaction, frustration, and propensity to leave, has recently received considerable attention in the literature. The impact of constraints in Air Force work settings has been the focus of this recently completed R&D effort. The primary purposes were (a) to develop a taxonomy of situational constraints found in Air Force work settings, (b) to develop objective measures of these constraint dimensions, (c) to validate the constraint measures against work outcomes, and (d) to test hypothesized relationships between constraints and relevant work outcomes within an Air Force context. The work consisted of four phases, described briefly below.

TECHNICAL ACHIEVEMENTS

Phase I involved development of a taxonomy of situational constraints applicable to a wide range of Air Force work settings and specialties. An open-ended questionnaire employing a critical-incident methodology was administered to airmen at bases dispersed across the United States and was used to generate specific instances in which situational variables were cited as an explanation for poor performance. A content analysis of the critical incident data resulted in the identification of the following 14 constraints: tools and equipment, training, materials and supplies, job-relevant information, planning/scheduling of activities, time, cooperation from others, personnel, physical working conditions, red tape, forms, policies and procedures, transportation, and job-relevant authority.

Phase II involved development and evaluation of an objective questionnaire to measure the Phase I constraint dimensions. Questionnaires were administered via mail to airmen stationed throughout the world. Preliminary validation of the constraint measures against selected criteria was also accomplished. Significant

correlations in theoretically appropriate directions were observed between dimensional and overall constraint scale scores and satisfaction, frustration, and reenlistment intent criteria.

Phases III and IV involved on-site survey administration to airmen in seven different Air Force specialties at four Air Force bases. These phases were designed to validate the refined constraint measure against affective and reenlistment criteria as in Phase II, as well as performance and other criteria. Phase IV used a large sample to provide in-depth examination of a single AFS, and to test selected research hypotheses. The results of Phases III/IV were mixed and often contrary to expectations. The severity of constraints experienced was lower than anticipated across all AFSs investigated. Perhaps for this reason, a clear or consistent negative relationship between constraints and performance was not observed. Constraints had an adverse impact on some, but not all, aspects of motivation measured. They were also related to thoughts of leaving but not to reenlistment plans. This unexpected finding may be due to a downturn in the economy which made it difficult for those who thought of leaving to actually leave. The strongest and most consistent findings had to do with affective reactions. As in Phase II, constraints were consistently associated with decreased job satisfaction and increased frustration.

FY84 Milestones. Data analyses for Phases III and IV were completed and a final Technical Paper documenting all four phases was completed. In addition a Technical Paper, which reviewed the situational constraints literature, was published.

Utilization: The present R&D effort resulted in the classification of situational constraints commonly found in Air Force work settings. Knowledge of such constraining factors should be helpful to Air Force managers in dealing with performance and productivity problems. Also, the current effort culminated in the development of a refined 42-item measure of constraints. In addition to being used in future R&D, the refined constraint scales can be used by managers as a diagnostic tool for identifying constraints operative in their own organizations, and determining the severity of such constraints.

Benefits: Once situational constraints are identified, their severity can be reduced or eliminated. Knowledge of factors that, depending on severity, may impede performance while increasing job dissatisfaction and frustration is extremely important. This R&D has provided Air Force managers with an understanding of (1) the constraints found in Air Force work settings, and (2) their impact on important work outcomes. In addition, the investigation has provided Air Force managers with a diagnostic instrument which can be used to gather information about constraints in a variety of operational work settings. This information can be used to make organizational and work group-specific changes to enhance performance and provide airmen with a more satisfying work environment.

Although situational constraints did not have much impact on the performance of the airmen studied, this investigation provided a technology to identify constraints in other Air Force work settings, where they may be more severe. Thus, this R&D provides Air Force commanders with a technique to identify, and subsequently, to reduce or eliminate, barriers to effective performance. In this way, productivity and mission effectiveness can be enhanced, particularly in work settings where constraints may be more pronounced than in the settings investigated in this R&D effort.

Title: NONAPPROPRIATED FUND SUPERVISORY APPRAISAL FORM OF EMPLOYEE PERFORMANCE

AFHRL Contact: Douglas K. Cowan
AFHRL/MOAO
Brooks AFB TX 78235-5000
Commercial (512) 536-2257
AUTOVON 240-2257

Description: A modified non-appropriated-fund (NAF) supervisory appraisal form (AF Form 2544) was developed and delivered to the Office of Civilian Personnel Operations (OCPO). The revised form will be used to evaluate and rate all NAF employees throughout the Air Force. Revised appraisal elements were developed through subject-matter specialist selection, field input, and judgment analysis (policy-capturing) of a promotion panel.

FY84 Milestones: Revised form completed and forwarded to OCPO on 15 Nov 83. The final report, AFHRL-TP-84-12, was published Jul 84.

Utilization: The revised form, developed to meet the requirements of the Uniform Guidelines for Employee Selection, will minimize the threat of litigation and will provide objective ratings that can be used to promote, remove, counsel, and reward nonappropriated fund employees.

Benefits: The revised form affords the individual supervisor an opportunity to evaluate and rate each employee's performance in a standardized way with ratings based on important job factors.

Title: REVALIDATION OF THE WEIGHTED AIRMAN PROMOTION SYSTEM

AFHRL Contact: C. Deene Gott
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2912
AUTOVON 240-2912

Description: The Weighted Airman Promotion System (WAPS) has been operational since July 1970 for all Air Force enlisted promotions to the grades of SSgt, TSgt, and MSgt. The system was developed at AFHRL in the late 1960s and extensively field tested before actual implementation. The WAPS system is composed of six promotion selection factors and corresponding weights, that are used to compute a total weighted factor promotion score for each individual. The components are summarized as follows:

WAPS Promotion Factor	Weight	Maximum Points
Specialty Knowledge Test	1	100
Promotion Fitness Examination	1	100
Time in Grade	1/2	60
Time in Service	1/6	40
Decorations	1	25
Airman Performance Reports	15	135
Total		460

Eligible enlisted members are compared with all other competitors in the same grade and career field on the basis of their total promotion scores, and a given percentage of the top scorers are selected for promotion. Each career field receives equal selection opportunities, that is, equal promotion quotas. The primary goal of the WAPS is to provide an equitable and visible promotion system.

Since the system became operational, extensive research dealing with the WAPS has been conducted at AFHRL. The current investigation objectives: (a) identify any changes in the weights of the current WAPS formula, (b) develop, if necessary, appropriate weights to assure the formula selections correlate highly with selections that would be made by a promotion board process, and (c) determine if different weighted factors could and should be introduced to improve the performance of the formula. The first major step of this study will involve conducting a workshop with all appropriate offices providing input regarding their research interests. Issues will be discussed and resolved, and specific plans for subsequent phases of the study will be formulated. Appropriate offices will include representatives from Air Force Headquarters, Air Force Manpower and Personnel Center, and the Air Training Command Occupational Measurement Center.

Some of the issues to be discussed include as standardized test scores, "front-side" evaluations of the Airman Performance Report, different formulas for each grade, procedures for Specialized Knowledge Test exempt career fields, and research methodology to be employed. The outcome of the workshop will determine the scope and magnitude of the total research project. Most likely, a "policycapturing model" of some type will be designed. Such methodology was used in the original development of WAPS and in two subsequent revalidations.

FY84 Milestones: A workshop was planned for early FY85 to determine the limitations, objectives, and scope of the research to be carried out.

Utilization: The WAPS currently handles approximately 45,000 promotions per year out of 240,000 eligibles. The analyses of the results of this project will enable decisionmakers to better evaluate experimental promotion systems in terms of the impact on minorities, females, and other criteria before recommending changes or improvements. The project will facilitate bringing the WAPS into better alignment with current Air Force management positions.

Anticipated Benefits: The results of this project will provide Air Force enlisted promotion policymakers with a current, scientifically defensible basis for making improvements to the operational WAPS and will enhance the goals of equitable and visible promotions. This, in turn, will assure that the best and most deserving enlisted personnel are selected for promotion to the important mid-level grades and impact positively on retention rates, quality of performance, and morale.

Expected Completion/Delivery: The workshop is scheduled for the first quarter of fiscal year 1985. Depending on the results of the workshop, the project may require from 8 to 15 months for completion.

Title: DEVELOPMENT OF WEIGHTED AIRMAN PROMOTION SYSTEM TEST OUTLINES

AFHRL Contact: William J. Phalen
AFHRL/MOMM
Brooks AFB, TX 78235-5000
Commercial (512) 536-2932
AUTOVON 240-2932

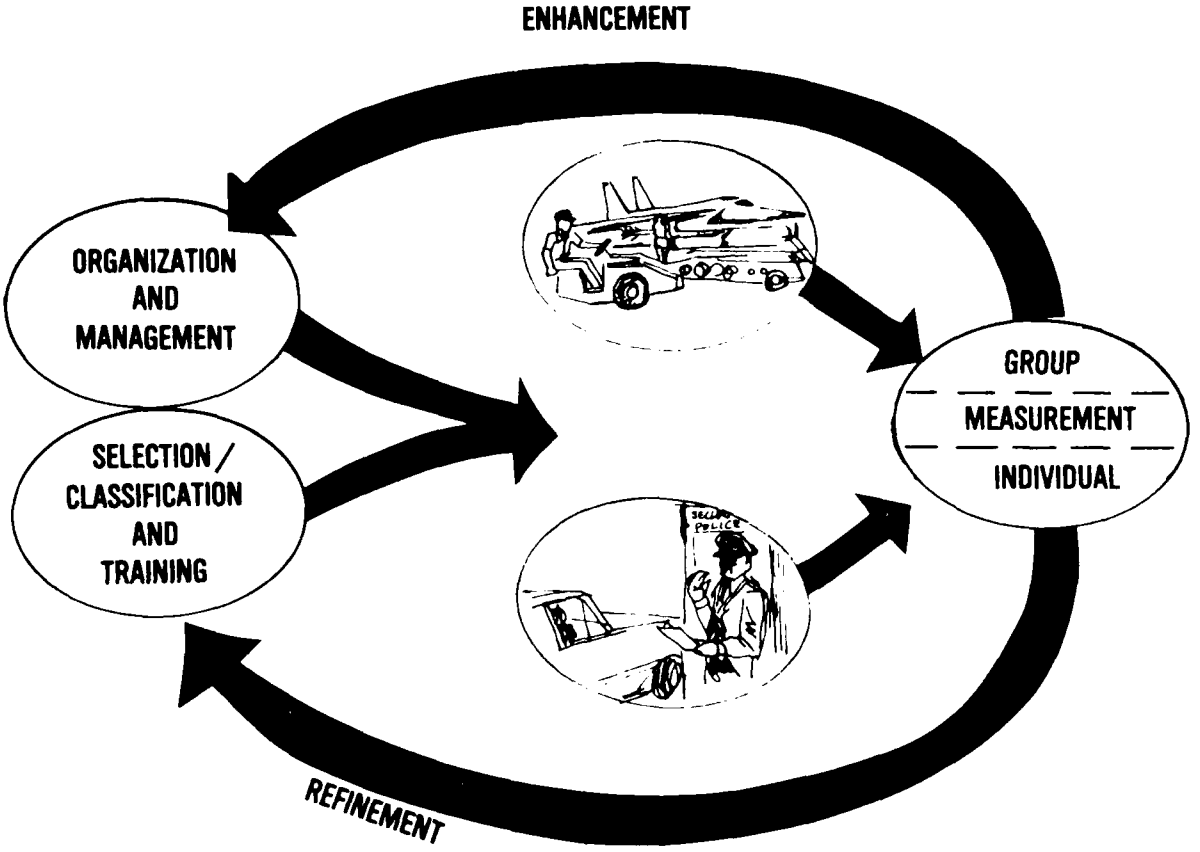
Description: The Air Force Occupational Measurement Center (USAFOMC) at Randolph AFB, produces the Specialty Knowledge Tests (SKT), which are an essential component of the Weighted Airman Promotion System (WAPS). The USAFOMC also develops and administers task surveys, within each Air Force specialty, to large samples of job incumbents who provide detailed descriptions of their jobs by selecting and time-rating the tasks they perform. A major goal of the USAFOMC is to integrate the two programs through the development of a valid, operationally feasible procedure for incorporating the occupational survey data into the SKT development process. This would enable the tests to be validated against "a systematic and appropriately comprehensive analysis of the job," as specified in the Uniform Guidelines on Employee Selection Procedures (U.S. Equal Employment Opportunity Commission, 1978). AFHRL has undertaken this project technology for incorporating occupational survey data into the development of WAPS test outlines. The achievement of this objective will involve the research and development of an operationally feasible, efficient procedure for screening, selecting, organizing, and analyzing survey data as a means of determining test content. It will also involve the development of measures for validating the procedure, such as a measure of correspondence between test content and job content, a measure of SKT subject-matter specialist acceptance of the procedure, and measures of the operational feasibility of the procedure.

FY84 Milestones: The project began with the initiation of work under a task-ordering contract and a kickoff meeting with the user group. Also, target SKTs were selected for development projects.

Utilization: If the objective of this project is met, as anticipated, the new, survey-based, automated outline procedure, which is more in consonance with the Uniform Guidelines, will operationally replace the current, more subjective, less reliable, SKT outline development procedure.

Anticipated Benefits: The most significant immediate benefit for the WAPS test development process will be substantial savings in time due to automating the process of screening, selecting, organizing, and weighting the huge occupational survey database used in the test development process, a procedure which is now extremely labor and time intensive. The most significant long-term benefit will be a WAPS test development process that is better attuned and more responsive to the continuously changing requirements of the Air Force workplace. The most significant immediate benefit to the Air Force Personnel System will be a more reliable and valid WAPS test for all enlisted personnel. The most significant long-term benefit will be a more equitable measure of broad job knowledge, which will ensure that the most qualified candidates will be promoted. In turn, WAPS will enjoy greater credibility, resulting in increased satisfaction and retention of more highly qualified enlisted personnel.

Expected Completion/Delivery: Dec 85



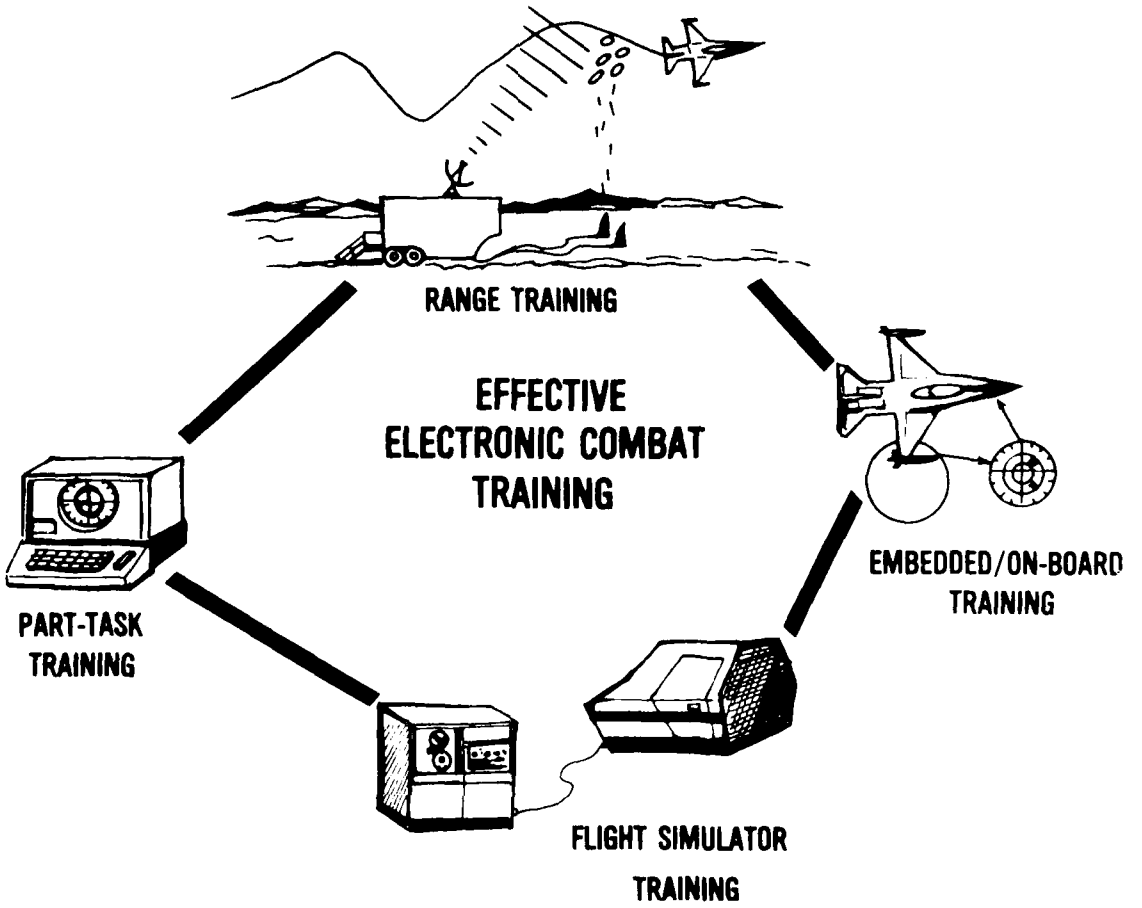
PRODUCTIVITY AND PERFORMANCE MEASUREMENT

Title: ENHANCING PRODUCTIVITY IN AIR FORCE ORGANIZATIONS THROUGH FEEDBACK, GOAL SETTING, AND INCENTIVES

AFHRL Contact: Charles N. Weaver
AFHRL/MODP
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: Past research demonstrates that feedback, goal setting, and incentives improve the performance of individuals doing simple jobs. These encouraging results suggested this research to determine the effects of feedback, goal setting, and incentives on the productivity of groups performing the complex jobs typical of the work done in operational Air Force organizations. In addition, this research will suggest a solution to the important methodological problem of aggregating productivity measures from lower to higher organizational levels. The effort has four major objectives: (a) to field test the generalizability of feedback, goal setting, and incentives to operational organizations, (b) to determine how much these enhancements increase productivity and how acceptable they are to Air Force personnel, (c) to design detailed procedures for developing and aggregating productivity indices; and (d) to develop practical manuals that explain how managers can design and implement these measurement and enhancement technologies.

FY84 Milestones: Using the AFHRL-developed technology, the Methodology for Generating Efficiency and Effectiveness Measures (MGEEM), productivity measurement systems were developed in two organizations, a Materiel Storage and Distribution Branch of a Supply Squadron and a



FY84 Milestones: Selection of design specification source was made during the third quarter and contract for design specification was awarded during the fourth quarter.

Utilization: The MATS design study will support the development, implementation, and evaluation of MATS. This application of advanced training technology and practices should produce improved delivery capabilities and more effective training, resulting in expanded training capacity and improved aircrew performance. Integrating all phases of training into a single system should eliminate gaps and overlaps that currently exist, including those between formal schools and operational units. MATS would provide for effective use of existing resources and training media, especially the full exploitation of combat training capabilities of the C-130 weapon system trainer. This training system will serve as a prototype that will provide opportunities both to illustrate and to evaluate advanced training technology applications. A major product of the MATS program would be a set of guidelines for total training system design. The guidelines would initially focus on tanker/transport/bomber applications, but would ultimately be generalized to the advanced tactical fighter program.

FY84 Milestones: The majority of the Phase I efforts were completed during FY84. In connection with TAC, the effects of real-time and postmission feedback, as well as skill retention, were examined using the Advanced Simulator for Pilot Training. Pilots were trained under varying feedback conditions and tested in a common test environment. Some of the pilots then returned to the AFHRL Operations Training Division after a period of 3 to 6 months for retesting to evaluate skill retention.

In a related effort, some of the pilots participating in the feedback study were pretrained for the Green Flag 84 exercise, and their performance during this exercise was compared to that of non-pretrained pilots. Preliminary results from these studies indicate the following: (a) feedback is critical for learning, (b) postmission feedback can compensate to a significant degree for lack of real-time feedback, (c) skill degradation is a function of time without practice and level of initial learning, and (d) training in the simulator benefits performance in flight, at least at the beginning of an exercise.

With regard to SAC, a study was conducted concerning the relationship between B-52 Electronic Warfare (EW) officer performance and resultant missile miss distance scores from in-flight training at a threat simulator (MPS-T1) equipped Strategic Training Range. The basic finding was that there is no systematic relationship between EW performance and MPS-T1 scores. Such scores are currently used in both daily training as well as in special exercises. The results of the MPS-T1 study were briefed at HQ SAC and to the June 1984 Range Improvement Program Review. Preliminary results from the TAC related efforts was briefed at the January 1985 review, with a final report on Phase I to be completed by Sep 85.

Utilization: As a result of the MPS-T1 experiment, HQ SAC is currently investigating alternative ways to conduct MPS-T1 scoring. Data from Phase I will be used by the Armament Division at Eglin AFB to aid in determining requirements and providing supporting evidence for future range systems. Data from Phase II will play a key role in an integrated plan by Headquarters USAF to develop an advocacy and investment strategy for EC training systems. Such information is critical to respond to the recently surfaced concern over the lack of an overall strategy for EC training. For TAC and SAC, this R&D will aid in defining presently unknown requirements for EC training and in establishing necessary levels of aircrew proficiency and will provide indicators of EC training effectiveness.

Title: MODEL AIRCREW TRAINING SYSTEM DESIGN STUDY

AFHRL Contact: Robert T. Nullmeyer
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The Model Aircrew Training System (MATS) is a joint program between the Air Force Systems Command and the Military Airlift Command to apply advanced training development, delivery, evaluation, and management concepts to aircrew training. The prototype system will be tailored to C-130 training requirements, but MATS will also serve as a model for other aircrew training programs and as a test bed for evaluating the concepts and technologies that are incorporated in the resulting training system. MATS will tailor training to the needs of individuals through innovative management and through utilization of available training resources, employing proficiency-based instruction and advancement. The major components of MATS will be (a) the training curriculum, including learning objectives, performance standards, evaluation procedures, media selection, syllabuses, and quality control procedures, and (b) a computer-based support system to provide for training program development, instructional delivery, evaluation of crew performance, and management of all training resources.

An effort is currently underway to develop the design specification for MATS. The study includes reviews of current training technologies and practices, program evaluation techniques, and C-130 mission requirements. A system architecture will be developed. Design options will be defined, and trade-off analyses will be accomplished to select the optimum alternatives. The primary products of this design study will be the system specification, a system development and implementation plan, and a test and evaluation plan.

FY84 Milestones: The Airborne Design Study was completed during the fourth quarter.

Utilization: The simulator performance measurement system is currently being used in support of the copilot training curriculum. Three of the nine missions in the copilot course have been implemented on the system. Information that is generated from these missions will be used by AFHRL in support of the evaluation of the system. These results will aid in the specification of performance measurement requirements for future simulators.

Anticipated Benefits: The primary benefit lies in the implementation of these capabilities in future systems. As such, they can provide the user with the means for quantitatively assessing the effectiveness of their simulator training programs.

Expected Completion/Delivery: May 85

Title: AIRCREW TRAINING TASK SURVEYS

AFHRL Contact: Bernell J. Edwards
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The AFHRL Operations Training Division is conducting a series of opinion surveys of operational aircrew personnel to determine their perceptions about the effectiveness of training and the potential use of new low-cost technologies to support training for tasks they perform in operational aircraft. The survey asks the aircrew member to rate each task performed during a mission in terms of (a) how effectively it is being trained in the current program, (b) its relative difficulty as a training task, (c) the estimated sophistication of the training device required to support training for the task, and (d) the potential utility of microcomputer-based technology to support training for the task. Training surveys completed to date are those for aircrews of the C-130 (Military Airlift Command), the B-52 and the KC-135 (Strategic Air Command). Surveys for C-141, B-1B, F-15, and F-16 aircrews are in various stages of completion.

FY84 Milestones: Data collections were completed for the crews of the C-130, B-52 and KC-135 aircraft during the third and fourth quarters.

Utilization: Survey data are providing essential, basic information to identify, classify, and prioritize tasks and subtasks according to behavioral characteristics required. This is intended as a means of identifying types of tasks/subtasks for which training via microcomputer-based aircrew training devices (MATDs) is supportable. This will permit the specification of technology in terms of the behavioral requirements of tasks to be trained.

Anticipated Benefits: The primary benefit of the aircrew task surveys is the collection of data that will aid in the definition of low-cost training technology which possesses sufficient power and flexibility to impact a wide range of aircrew training requirements. Data from this R&D will be used to develop a handbook of guidelines for operational users to MATDs.

Title: ELECTRONIC COMBAT TRAINING EFFECTIVENESS

AFHRL Contact: Thomas H. Killion
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The objective is to provide a basis for decisions concerning the development and acquisition of Electronic Combat (EC) training systems. The first phase of this effort is being conducted in support of the Deputy for Range Systems of Armament Division, Eglin AFB. These experiments address issues relevant to the capabilities and numbers of threat simulator systems used in EC range training. The primary emphasis is on feedback requirements and frequency of training. The experiments involve both the Tactical Air Command (TAC) and the Strategic Air Command (SAC). Phase II will be conducted in support of Headquarters USAF, and will address the full spectrum of EC training systems (e.g., part-task trainers, operational flight trainers, and in-flight systems) to determine their capabilities to support various aspects of EC training and to evaluate an approach to integrating them into an overall program.

Title: C-5A AIRCREW PERFORMANCE MEASUREMENT SYSTEM

AFHRL Contact: Wayne L. Waag
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: There remains a critical need to achieve maximum training value from Air Force simulators. This requires determining the relationship between aircrew performance in the simulator and subsequent performance in the aircraft. A project has been initiated to address this problem by developing an integrated aircrew measurement system for use on the ground and in the air. The goal is to develop a computer-based system that will generate objective indices of performance in both the simulator and the aircraft. A prototype system is being developed and tested for the C-5A. The approach was first to develop a measurement capability for the simulator, followed by an extension to the aircraft. The system acquires data directly from the flight simulator through several interfaces. It uses its own computational capability to generate the objective measures of aircrew performance. For the aircraft, objective flight data would be recorded and processed on the ground using the simulator performance measurement system so that equivalent measures would be produced. To date, the simulator measurement system has been completed and successfully integrated with one of the C-5A simulators at Altus AFB. It is currently undergoing test and evaluation and is being used in support of the copilot training course at Altus. During FY84, the design study for the airborne system was completed. Because of the difficulty in accessing the necessary flight parameters, and the complexity of the interface requirements, the decision was made not to pursue the development of the airborne system.

Control of Flight Engineer Training with C-5A Aircrew Performance Measurement System

recording, and scoring of air combat engagements flown in the SAAC and on the ACMI, (b) implementation of the AAMI scoring technique, (c) real-time graphic feedback, (d) graphic replay for debriefing, (e) hardcopy debriefing reports; (f) data storage and analysis, and (g) growth provisions for the development and testing of alternative scoring procedures and graphic display formats.

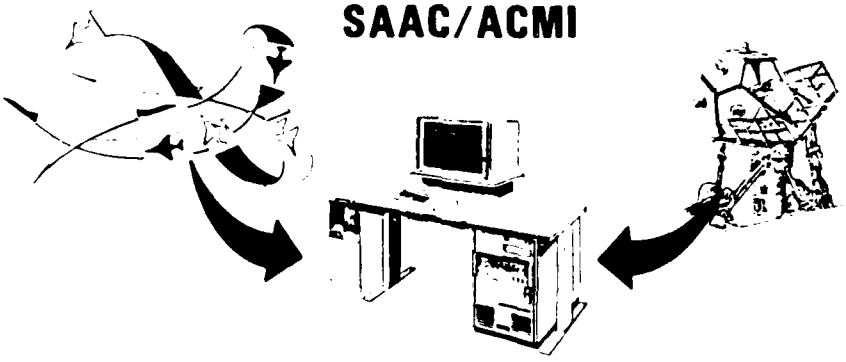
FY84 Milestones: Development contract was awarded during the fourth quarter.

Utilization: The air combat maneuvering performance measurement system will provide the means for the Tactical Air Command to quantitatively assess engagements flown in the simulator and on the range. It will provide enhanced mission feedback, thus improving the effectiveness of available training resources. The system will also provide AFHRL with the needed measurement test-bed facility for the pursuit of air combat training R&D.

Anticipated Benefits: At present, the lack of an objective means of assessing air combat maneuvering performance has prevented certain critical issues from being properly addressed. The development and validation of such objective measures would enable questions to be answered that could potentially impact the combat readiness of our forces. First, it would enable the precise definition of air combat training event requirements, and thus would permit flying-hour requirements to be based on aircrew proficiency needs rather than on best guesses. Second, it would provide the tools necessary for establishing simulator utilization requirements for initial skill acquisition, as well as for continuation training.

Expected Completion/Delivery: 1 Apr 86

Air Combat Maneuvering Performance Measurement System for SAAC/ACMI



Title: PERFORMANCE MEASUREMENT SYSTEM DESIGN GUIDELINES FOR AIRCREW TRAINING DEVICES

AFHRL Contact: Wayne L. Waag
AFHRL/OTU
Williams AFB, AZ 85420-6457
Commercial (602) 988-6561
AUTOVON 474-6561

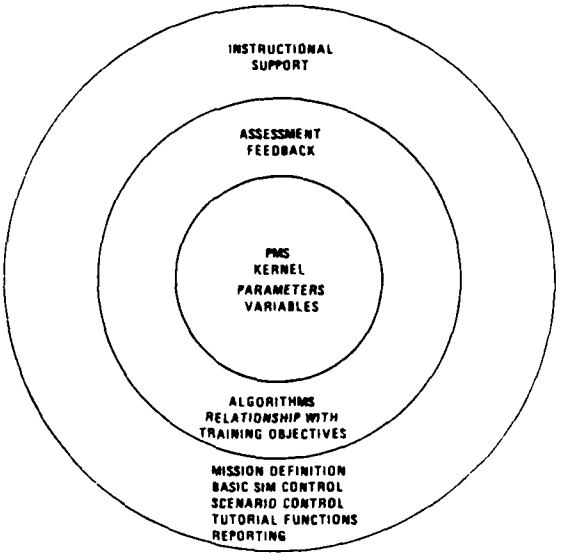
Description: The objective of this effort is to develop a set of guidelines to aid in the specification of performance measurement system (PMS) requirements for future simulator acquisitions. At present, there exist no guidelines for specifying PMS requirements in sufficient detail. The guidelines to be developed will address all aspects relating to the design, development, and incorporation of PMS capabilities within aircrew training devices (ATDs). They will include system-level features such as mission-generation capabilities, PMS control functions over the basic simulation, instructor interface/control requirements, and data storage and analysis requirements. A considerable portion of the guidelines will address measurement requirements at the task level. Considerations include: (a) functional capabilities such as start/stop logic, measures to be generated, display formats for immediate feedback, summary scores, and post-mission debriefing formats, (b) software requirements such as parameters to be sampled and their rates, and (c) hardware implications such as memory size/speed and interface requirements. In sum, the guidelines will primarily address the functional requirements for a PMS in ATDs and the resulting hardware and software implications.

FY84 Milestones: Contract was awarded during the third quarter.

Utilization: The primary user of such guidelines will be the Simulator Systems Program Office (SIMSPO), although secondary users would include the Major Commands which often specify training device requirements, and the simulator manufacturers.

Anticipated Benefits: The resulting guidelines will enable the precise definition of flight simulator measurement requirements and allow estimates of the required hardware/software to support implementation.

Expected Completion/Delivery: Sep 85



Guidelines for Aircrew Training Devices

Title: AIR COMBAT MEASUREMENT SYSTEM FOR THE SIMULATOR FOR AIR-TO-AIR COMBAT AND THE AIR COMBAT MANEUVERING INSTRUMENTATION

AFHRL Contact: Wayne L. Waag
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The specific problem addressed in this R&D is the lack of a performance measurement system for the Simulator for Air-to-Air Combat (SAAC) and the Air Combat Maneuvering Instrumentation (ACMI). The SAAC is the only Air Force simulator used for close air-to-air combat training. The ACMI, on the other hand, enables the monitoring of airborne engagements. At present, neither of these devices has an air combat measurement capability. During FY83, a project was completed that refined the all-aspect maneuvering index (AAMI), an air combat measurement technique originally developed for the U.S. Navy. This effort also developed a design specification for a stand-alone measurement system that could be integrated with both the SAAC and ACMI. During FY84, a contract was awarded for the development of this prototype system. The air combat measurement system will have the following capabilities: (a) real-time monitoring,

desirable for evaluation purposes. A unitary performance measure could be used to determine general pilot proficiency prior to training, the effectiveness of alternative training techniques, and the relative difficulty of different training scenarios.

Benefits: A relatively simple method for scoring the outcomes of complex multidimensional behavior in simulated combat situations is of great utility to researchers and training system managers for assessing the impact of a wide variety of factors on pilot performance.

Title. C-130E WEAPON SYSTEM TRAINER OPERATIONAL TEST AND EVALUATION

AFHRL Contact: Robert T. Nullmeyer
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: AFHRL supported a Military Airlift Command (MAC)-managed, MAC-directed follow-on operational test and evaluation (FOT&E) of the C-130 Weapon System Trainer (WST). The training effectiveness of this device was evaluated for both formal school and continuation training applications. The primary goal in this effort was to assess the impact of the visual system on WST training effectiveness. Transfer of training from the WST to the C-130 aircraft was evaluated for tasks that require out-the-window visual cues.

In the first of three experiments, student copilots in the test group received training for visual approaches, landings, and engine-out go-arounds in the WST, while the control group did not. Dependent measures were proficiency ratings, estimates of instructor input, and selected objective performance parameters all collected during in-flight accomplishment of these tasks. The primary changes over sorties for both groups involved performance ratings and instructor inputs. As students learned tasks, instructor inputs decreased. WST training did have a major impact on both proficiency ratings and instructor input, virtually eliminating the hands-on intervention that ordinarily occurs in early flight training. The objective performance measures appeared relatively insensitive to either changes over sorties or WST training.

In the second experiment, student pilots, copilots, and navigators, who received training in the WST for lead-in and formation flight, maximum effort landings, and recoveries, performed at a higher level in flight for all of these tasks than did their non-WST-trained counterparts, as measured by the percentage of students rated proficient and by trials to criterion.

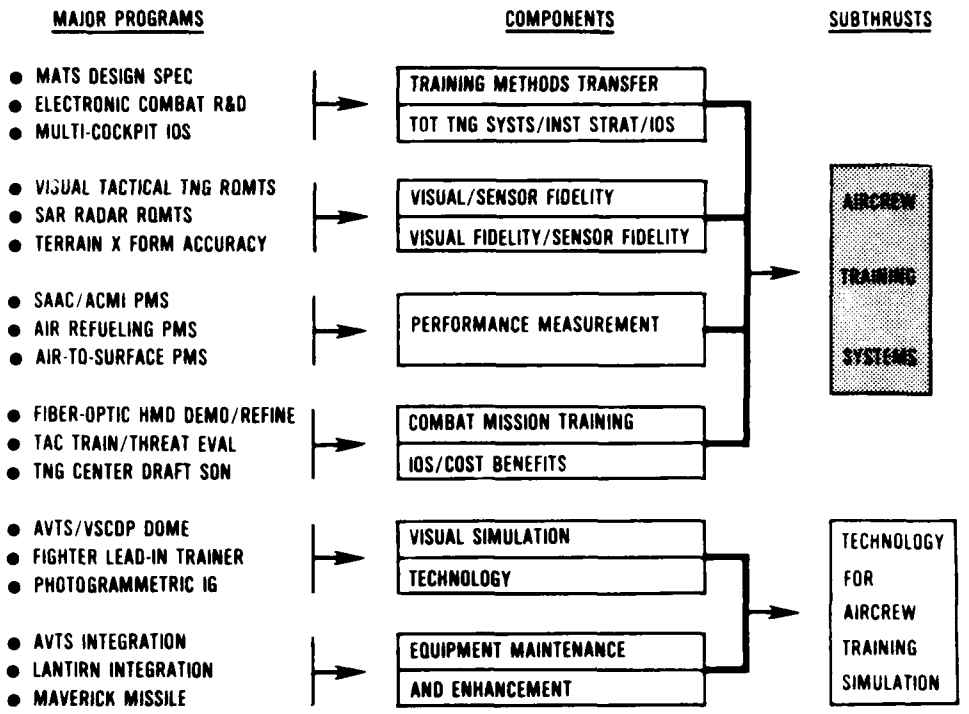
The WST training effectiveness for continuation training was measured in a third study. The training tasks were three-engine takeoff and windmill taxi starts, low-altitude parachute extraction system airdrops, combat aircrew training, and night vision goggles operations. In each case, WST training was shown to benefit subsequent performance in flight.

FY84 Milestones: Data collection was completed during the first quarter. MAC final report was published in the fourth quarter.

Utilization: The results of this FOT&E impacted two areas. The first was a procurement decision regarding additional visual systems. Based on these studies, the MAC test team recommended procuring additional systems to support both formal school training and continuation training. A second area of impact has been in WST courseware modifications to improve training effectiveness. The results of these analyses suggested methods for improving the use of the WST to support training, such as providing training tailored to individual student needs and integrating the WST into the total system, which may affect all other components of the training system.

Benefits: Based partly on these FOT&E results and recommendations, MAC has procured additional visual systems to support both formal school training and continuation training. The lessons learned have been provided to C-130 course developers to guide modifications in WST curricula and have also been applied to other weapon systems.

AIRCREW TRAINING EFFECTIVENESS THRUST



AIRCREW TRAINING SYSTEMS — TECHNICAL ACHIEVEMENTS

Title: A UNITARY MEASURE OF PERFORMANCE FOR THE CLOSE AIR SUPPORT MISSION

AFHRL Contact: Gary S. Thomas
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: In the course of conducting simulator aircrew training R&D, it is often desirable to develop a single composite measure of pilot performance to readily assess the impact of various training strategies on pilot behavior. Such was the goal of this effort. The result was a validated unitary measure of A-10 pilot performance for simulated close-air-support missions (CAS). Using mission-qualified A-10 pilots as expert judges, overall CAS mission performance for outcomes typical of those obtained in the Advanced Simulator for Pilot Training (ASPT) were evaluated using a card-sorting procedure. The critical parameters on these stimulus cards dealt with pilot survival, and number and type of targets destroyed. A linear regression analysis of the judgments resulted in a mathematical formula that assigned differential values to mission survival and to destroying high-value targets (e.g., a command post, tanks, and threats).

The formula was cross-validated using the same procedure, but with a separate group of A-10 pilots judging performance for a different set of CAS mission outcomes. To test the sensitivity of the scoring algorithm to CAS training, data from a previous study on A-10 pilots trained in ASPT were reanalyzed using the formula. CAS performance as calculated by the algorithm increased significantly across training trials, suggesting that performance scores generated by the formula accurately reflect increments in training.

FY84 Milestone: Final draft of Technical Report describing R&D results was completed.

Utilization: The procedure for developing a unitary performance metric can be useful in other training research where a composite measure is

AIRCREW TRAINING EFFECTIVENESS

MANPOWER AND PERSONNEL DIVISION R&D PRODUCTS

1. Armed Services Vocational Aptitude Battery (ASVAB) Forms 14a, 14b, and 14c.

   Utilization and Benefits: ASVAB Form 14 is the aptitude test battery given by Military Entrance Processing Command (MEPCOM) and Office of Personnel Management (OPM) test administrators to high school students. The scores are used by school counselors for vocational guidance and by service recruiters for leads to prospective service candidates.

   The scores remain in effect for 2 years for service enlistment purposes.

2. Counselor's Manual for ASVAB Form 14.

   Utilization and Benefits: High school counselors use the manual for vocational guidance. This manual helps market the Department of Defense (DoD) Student Testing Program for high schools, which aids in recruiting.

3. ASVAB Information Pamphlet.

   Utilization and Benefits: Recruiters distribute this pamphlet to prospective applicants for service enlistment. This pamphlet increases the number of applicants by alleviating fear of the ASVAB and by increasing familiarity with the test content.

4. ASVAB-14 Administration Manual.

   Utilization and Benefits: Military Entrance Processing Stations and OPM test administrators use this manual to standardize the administration of the ASVAB to high school students.

5. ASVAB-14 Conversion Tables.

   Utilization and Benefits: The conversion tables are used by Military Entrance Processing Command (MEPCOM) to convert raw scores on the ASVAB Form 14 to grade and gender norms for high school students. This makes the test useful to high school counselors and opens up high schools to the DoD Student Testing Program.

6. Conversion Tables for the Armed Forces Classification Test (AFCT).

   Utilization and Benefits: The various services (Army, Navy, Air Force, and Marines) use the AFCT for in-service aptitude testing for such purposes as cross-training. These tables allow the in-service testing programs to produce classification composite scores which are comparable to the current ASVAB composite scores.

7. Conversion Tables for the National Guard Selection and Classification Test.

   Utilization and Benefits: These tables allow National Guard selection and classification to be based on scores comparable to the current ASVAB composites.

8. Conversion Tables for ASVAB Forms 11/12/13.

   Utilization and Benefits: The conversion tables are used by MEPCOM to assign operational selection and classification scores for the various services. These tables allow the services to maintain their personnel systems for recruitment and enlistment.

9. Conversion Tables Between 1944 and 1980 Metric Air Force Composite Scores.

   Utilization and Benefits: ASVAB scores previous to 1 Oct 84 have been scaled to a 1944 reference group; scores after that date are scaled to a 1980 reference group. These conversion tables will allow managers at the Air Force Manpower and Personnel Center to convert scores of record, that were recorded before 1 Oct 84, to the new metric for purposes of cross-training, research or projections.

evolve over time. The open-system perspective acknowledges that the Air Force is embedded in a larger context and that factors in the external environment, such as perceptions of desirable and obtainable alternative jobs, can have an impact on stay/leave decisions.

A hybrid model of personnel turnover served as the conceptual foundation for this effort. This model integrates and expands on existing models and is specifically tailored for Air Force use. It provides a coherent framework for examining a promising set of biodemographic, attitudinal, perceptual, and economic variables that are likely to influence stay/leave decisions. A paper-and-pencil survey instrument, the United States Air Force Retention Survey (USAFRS), was administered to a world-wide sample of 3,998 first- and second-term enlisted personnel in eight Air Force occupational specialties. Data obtained from this source was integrated with data from personnel files and other sources. Refined, empirically-derived scales were developed through the use of cluster, factor, and internal-consistency analyses. Predictors in the hybrid model are currently being investigated using least-squares regression and discriminant analysis techniques to determine their impact on propensity to stay/leave behavior, intent, and other intermediate-linkage variables such as commitment and thoughts of leaving and search. These analyses are being conducted for the entire sample and for each occupational specialty.

FY84 Milestones: The USAFRS was administered to a world-wide sample of enlisted personnel via direct mail. A data file was created and analyses were performed to validate and refine the hybrid model of turnover. Preliminary tests of the resulting empirical model were performed against a variety of intermediate and final criteria using regression and discriminant analysis techniques.

Utilization: This R&D effort will be useful to Air Force researchers and managers by increasing their understanding of the factors influencing airmen to remain in the Air Force or to leave it. This investigation will also enhance the ability of Air Force researchers and managers to predict turnover behavior before such behavior actually occurs, allowing remedial action to be taken to induce valued members to stay. This R&D program will provide information for making informed accession and personnel management policy decisions that should result in the ability of the Air Force to retain more of its experienced, productive personnel by making the Air Force a more attractive career option. Potential retention problems can be forecast before they occur, and the Air Force will be better prepared to deal with the increased propensity of members to leave as the economy improves.

Anticipated Benefits: This R&D will allow the Air Force to identify the most pressing factors influencing the stay/leave behavior and intentions of enlisted personnel in several occupational specialties in which a critical shortage of skilled personnel has been experienced. This information can be used by Air Force managers to refine Air Force policies and practices to induce valued personnel to remain in the Air Force.

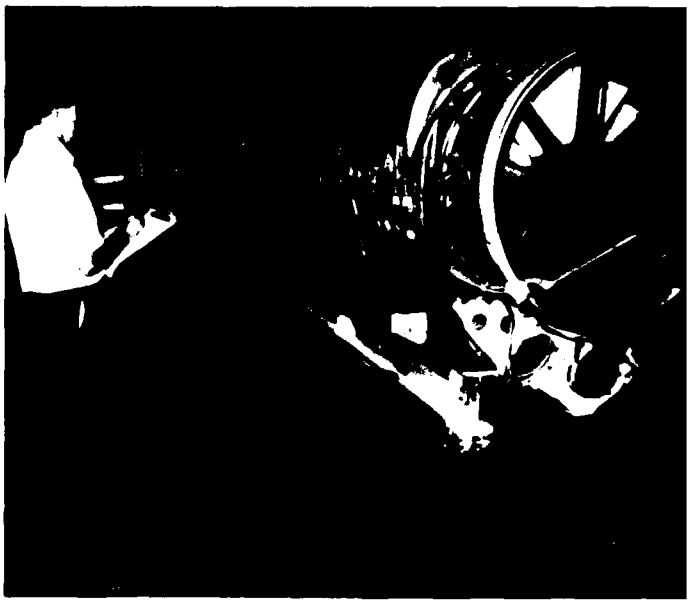
Expected Completion/Delivery: This R&D shall be completed by Sep 85.

FORCE MANAGEMENT SYSTEM

Title: EVALUATION OF INDIVIDUAL PERFORMANCE IN MECHANICAL SPECIALTIES

AFHRL Contact: Suzanne Lipscomb
AFHRL/MODP
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: A prototype performance assessment methodology has been developed to investigate the utility of various measures of on-the-job performance. The methodology consists of a general framework of instruments and techniques and a set of clear-cut decision rules that can be applied to the content of each job to develop performance measures. A pilot test of the methodology has been conducted. Performance assessment instruments and experience and interest questionnaires have been developed for the Tactical Aircraft Maintenance Career Field (431X1).



Evaluation of Mechanical Competence

FY84 Milestones: The measurement system was used to collect performance data on 210 Tactical Aircraft Maintenance specialists. A preliminary analysis of the data was conducted to investigate the association among the measurement instruments and also between the measurement instruments and factors related to performance. The results indicated that the component performance measures were relatively independent, each assessing different aspects of the performance domain. The factors that were expected to be related to performance (e.g., experience, rank, and motivation) were found to be logically and meaningfully related to the performance measures, which indicates that the measures reflect actual job performance. Further analyses will be conducted to investigate the association among the job performance measures, factors related to job performance, and predictors of performance such as ASVAB scores.

Utilization: The results of this study will be used to better define the relationship between the qualities of people entering the 431X1 career field and their on-the-job performance. This information can be used to enhance the selection and assignment system and indicate areas where training enhancements may improve job performance. Additionally, many of the lessons learned in this study, such as task selection and testing procedures, have been used to develop the performance measurement technology for use in the Joint-Service Performance Measurement Project.

Anticipated Benefits: By relating enlistment standards and training outcomes to actual measures of on-the-job performance, commanders and supervisors will be more likely to have personnel assigned who possess the required abilities and knowledges to be good performers.

Title: A PROCESS MODEL OF TURNOVER WITHIN AN OPEN-SYSTEMS CONTEXT

AFHRL Contact: Thomas W. Watson
AFHRL/MOD
Brooks AFB, TX 78235-5000
Commercial (512) 536-2257
AUTOVON 240-2257

Description: The Air Force is interested in retaining experienced, productive personnel and is therefore concerned about factors influencing separation and retention decisions. This R&D effort involves an assessment of the determinants of stay/leave decisions and takes process and open-system perspectives in examining this issue. The process perspective acknowledges that decisions to stay or leave

Title: JOB PERFORMANCE CRITERION DEVELOPMENT FOR THE JET ENGINE MECHANIC

AFHRL Contact: Jerry W. Hedge
AFHRL/MODP
Brooks AFB, TX 78235-5000
Commercial (512) 536-3551
AUTOVON 240-3551

Description: Recently, the Air Force has begun a long-term R&D effort to systematically obtain job performance measures that will serve as criteria for validating selection systems, and for evaluating training programs and the effects of personnel policies and procedures. The first occupational specialty selected for development and testing of job performance measures is the Jet Engine Mechanic (426X2).

A new work sample methodology, Walk-Through Performance Testing (WTPT), is the cornerstone of this developmental effort. This methodology is a task-level job performance measurement system that combines on-site evaluation and interview procedures to provide a high-fidelity measure of individual task-oriented capability. A wide range of alternative job performance measures have been developed in addition to the walk-through testing methodology. These include task-level, dimensional, global, and Air Force-wide ratings by peers, supervisors, and job incumbents. Data on approximately 350 first-term jet engine mechanics will be collected and analyzed by the end of FY85.

FY84 Milestones: During FY84, developmental work continued on WTPT. Tasks representative of a first-termer's job were identified and finalized in 1st Quarter of FY84. Work sample test items were then developed based on these tasks, with development being completed by 4th Quarter FY84. Rating form development was initiated in the 2nd Quarter of FY84, and also completed by the end of FY84. Former jet engine mechanics were hired as test administrators, and given additional training on WTPT and rating form administration in the last two quarters of FY84.

Utilization: These job performance measures are needed for R&D and evaluation of operational Air Force programs (i.e., selection, classification, training) and are also necessary to comply with recent Congressional mandates that enlisted selection tests be validated against hands-on job performance measures. Validation of civilian selection and promotion procedures against job performance measures must also be accomplished.

Hands-on Performance Evaluation

Anticipated Benefits: Development of techniques to assess on the job performance in the jet engine mechanic career field will provide the basis for validating the enlistment and classification standards currently used in the Air Force. For any particular career field, this will ensure that personnel selected and classified for a specific job will have the specific aptitude and general intellectual level required for the job. This should benefit operational commanders and supervisors in having personnel with the requisite aptitude not only to become good performers, but also to profit from the training and experience obtained on the job. The development of a valid and reliable measurement system for this specialty will provide the basic prototype for assessing job performance more accurately in all career fields -- enlisted, officer, and civilian.

Expected Completion/Delivery: A final report documenting development and evaluation efforts for the Jet Engine Mechanic specialty will be available in FY86.

Communications-Navigation Section of an Avionics Branch. Key Results Areas (KRAs), indicators of KRAs, and data source for indicators were identified and computerized to create automated productivity measurement systems. The systems operated to produce baseline data on the status of productivity against which the effects of forthcoming feedback, goal setting, and incentive system interventions will be compared. Anticipating their experimental use in the organizations, feedback systems were planned and a taxonomy of non-monetary incentives for Air Force personnel was developed.

Utilization: The productivity measurement system will provide productivity information at the work group level, which could be aggregated for the entire organization. Information as to how feedback, goal setting, and incentives enhance productivity and the practical manuals for implementing these interventions should facilitate the use of these techniques throughout the Air Force.

Anticipated Benefits: This AFHRL R&D will provide Air Force commanders with manuals for the field use of feedback, goal setting, and incentive systems to increase the productivity of their organizations. The manuals will explain how feedback, goal setting, and incentive systems are developed, including a description of alternative ways to increase productivity; methods of feedback, goal setting and incentive design; and examples of real-life applications. Incentives will be listed according to their desirability to Air Force personnel. Each manual will include an evaluation system to be used with the feedback, goal setting, and incentive program so that productivity improvements can be documented.

Expected Completion/Delivery: Mar 87

Title: RESEARCH AND DEVELOPMENT OF A TRAINING DECISIONS SYSTEM

AFHRL Contract: Wayne B. Archer
AFHRL/MODJ
Brooks AFB, TX 78235-5000
Commercial (512) 536-3648
AUTOVON 240-3648

Description: The R&D of a Training Decisions Systems (TDS) is aimed at providing advanced decision aids for training planners to assist in developing overall training plans for any Air Force career ladder. The users' problem is in deciding which job skills and tasks would best be trained in resident schools and which would be best in field unit settings. Another decision is what proficiency levels the training should reach for entry-level and advanced assignments. The Training Decisions System will bring computer-assisted decision models to bear on this problem, taking into account complex tradeoffs among training, personnel, and cost factors, and considering the policy preferences of training, personnel, and functional managers.

FY84 Milestones: An advisory group, consisting of future TDS users, was formed. A feasibility analysis on TDS methods for defining job content was performed. The advisory group conducted a progress review. Scientists began work on the system transition plan. A TDS system design was initiated. A purchase request for a portable model for user tryouts and demonstrations was completed.

Utilization: Products will be used by major air commands in determining training requirements, by Air Training Command in developing plans for training course content and budgets, and by Air Staff functional managers in evaluating training proposals.

Anticipated Benefits: At a minimum, this project will provide clear-cut pictures of utilization and training (U&T) options, with gross projections of relative impacts, as decision tools for training planners and a means for defining the training needs and preferences of training customers. If fully successful, the results of this project will accurately forecast the cost consequences of alternative U&T strategies and will aid in developing optimized training plans, based on users' criteria. In either case, the effort will help the Air Force to make demonstrably more effective use of training resources.

AIRCREW TRAINING SYSTEMS

TITLE: ARTIFICIAL INTELLIGENCE RESEARCH IN PILOT TRAINING

AFHRL Contact: Thomas M. Longridge
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Project 1 - Visual Attention

Description: Research in Artificial Intelligence (AI) is a major new subproject within the AFHRL Operations Training Division's basic research program. Entitled "Cognitive Determinants of Visual Attention," this effort has as its objective the development of a goal-directed AI model of visual attention. The initial focus of the model will be on instrument-guided control. The general computational approach will involve the exploration of activation-based models of goal selection and the comparison of associative and optimal models in terms of their systematic errors. Issues to be investigated in the course of building the model include: (a) voluntary and involuntary attentional shifts within a single fixation, (b) the extent to which monitoring behavior differs from optimal, (c) what kinds of information can influence attentional goal selection, (d) whether adding lateral intergoal interactions improves predictions of the model, (e) whether there is evidence for cumulative activation/decay processes, (f) whether multicycle iterative computation improves the model's predictions, and (g) whether there is evidence for an eye movement buffer.

FY84 Milestones (Project 1): Software was developed and debugged for display of attentional targets. Collection data on voluntary vs. involuntary attentional shifts was completed, and Xerox 1108-106 Scientific Information Processor for AI programming was procured.

Utilization: During FY84, research was conducted on the first issue above, and established that dramatic improvements in the speed of voluntary attentional shifts within a single eye fixation can occur with training. This work will provide empirical data needed in order to build a predictive AI model incorporating attentional processes.

Anticipated Benefits: As a basic research project, this effort will advance the state-of-the-art in the field of AI by demonstrating the predictive validity of a model which incorporates empirically established data concerning the operation, function, and timing of human attentional processes. In terms of its long-range potential, this effort will provide a computerized model of attention which could serve as a tool for the allocation of level of detail in area-of-interest visual displays.

Expected Completion/Delivery: 1 Oct 90

Project 2 - AI Modeling of Pilot Knowledge Structures and Decision Making

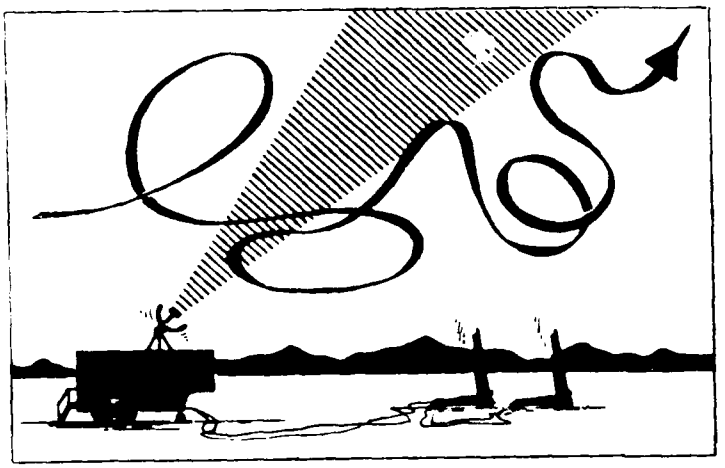
Description: A more applied use of AI technology at the Operations Training Division is an ongoing effort to develop an AI model of pilot decision making in air-to-air combat maneuver selection, using a knowledge-based expert production system approach. Input to the model will be provided by instructor pilots at Holloman AFB and by Air National Guard (ANG) pilots at Kirtland AFB. Work has been completed on the graphics representation of adversary aircraft and on the requisite flight equations. It is intended to investigate the training utility of this model for driving a desk-top trainer with students in fighter lead-in training at Holloman AFB. The effectiveness of the model in selecting maneuvers in an air-to-air engagement will be evaluated by comparison with the performance of an expert population provided with the same information as the model. The AI program is being written in Prolog for an IBM PC.

FY84 Milestones (Project 2): Pascal graphics subroutines and flight aerodynamics programs were created. Graphics and flight program functions were integrated. Liaison with expert fighter pilot population was established. An automated library of basic fighter maneuvers was also established.

Utilization: This AI model will be utilized as a training tool in air-to-air combat. It will provide an automated expert pilot for computer-assisted instruction in the selection of appropriate maneuvers as a function of the dynamic relationship of ownship and adversary aircraft in an air-to-air engagement.

Anticipated Benefits: By providing an opportunity for the development on a self-paced basis of a sound cognitive understanding of the rationale for maneuver selection in air-to-air combat, it is anticipated that more effective utilization of limited flying time available for student training in this domain will be realized.

Expected Completion/Delivery: 1 Oct 87



Simulator Training for Electronic Combat

Title: TACTRAIN/THREATVAL

AFHRL Contact: Ronald G. Hughes
Thomas Killion
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: TACTRAIN and THREATVAL represent two contract efforts initiated during FY84 which address pilot performance in the area of electronic combat training. THREATVAL is concerned with the requirements for real-time threat simulation and addresses specific requirements associated with A-10 and F-16 aircrew training. TACTRAIN is a separate, but related, effort and uses mathematical modeling methods (computer simulation) to derive effective maneuver-event sequences that, when performed by the A-10 and F-16 pilots, will result in a demonstrated improvement in survivability. The AFHRL interest in the identification of effective maneuver-event sequences is based on the behavioral concern as to whether such tasks are in fact trainable, and in the conditions under which such tasks are effectively maintained. This R&D is closely associated with the Operations Training Division work for the Air Force Armament Division in the area of electronic combat training effectiveness, as well as an effort with the 4440 Tactical Fighter Training Group (RED FLAG) regarding advanced aircrew training methods.

FY84 Milestones: Source selection and contract award were completed during the fourth quarter.

Utilization: The TACTRAIN and THREATVAL efforts are precursors to the conduct of R&D using the Advanced Simulator for Pilot Training to address in detail the effective use of simulators for electronic combat training. This effort is supportive of concerns of the Air Force Threat Simulator Working Group and its response to aircrew training needs in the area of electronic combat.

Anticipated Benefits: This R&D will result in information relevant to both the design and effective utilization of flight simulators for aircrew training in the area of electronic combat. When considered in conjunction with the range-related R&D efforts being supported by the Range Instrumentation System Program Office within the Air Force Armament Division, this R&D will serve to better integrate the complementary training assets of advanced simulators and advanced instrumented ranges, such as the RED FLAG Measurement and Debriefing System.

Title: PRELIMINARY INVESTIGATION OF LANTIRN FIELD-OF-VIEW ON PILOT PERFORMANCE

AFHRL Contact: Elizabeth L. Martin
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-2611
x6561
AUTOVON 474-6561

Description: The Advanced Simulator for Pilot Training (ASPT) in an F-16 aircraft cockpit configuration will be used in this project. The ASPT/F-16 will simulate the field-of-view (FOV) that will be provided in the Low-Altitude Navigation and Targeting Infrared Night (LANTIRN) heads-up-display (HUD) system. Three modes of operation will be simulated: (a) normal,

(b) look-into-turn, and (c) snap-look. These FOVs will be presented on the ASPT visual system using a computer-controlled FOV mask. The existing F-16 HUD will provide the pilot with flight information. The visual database will be a simulated high-threat, deep-strike scenario used in previous studies. Initial studies will document the effects of the LANTIRN FOV on selected aspects of the mission (navigation, target acquisition, weapons delivery, and threat avoidance). Subsequent studies will investigate the potential of alternative training strategies (e.g., gradual reduction of FOV) on the acquisition of skills necessary for the LANTIRN environment.

FY84 Milestones: Completed visual system software programming necessary to simulate normal, snap-look, and look-into-turns modes during the third quarter.

Utilization: The results of these studies will be used to identify potential training problems/solutions for future LANTIRN R&D in combat simulation.

Title: GENERIC SPECIAL FUNCTION TRAINER PROTOTYPES

AFHRL Contact: Bernell J. Edwards
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: One or more generic Special Function Trainers (SFTs) are to be developed and evaluated as demonstrations of the utility of low-cost technologies for aircrew training applications. Although the potential of "desk-top" devices appears promising, it is yet unclear precisely how and to what extent such trainers can reduce training costs by off-loading more expensive devices such as simulators and aircraft. For many of the cognitive and procedural aspects of tasks performed by aircrews, SFTs appear capable of providing the extensive amounts of practice associated with mastering the operation of complex weapon subsystems at reasonable costs.

FY84 Milestones: Initial planning was performed during the fourth quarter.

Utilization: The demonstration of this technology application is intended to provide empirical evidence in support of concept adoption for the widest possible application of aircrew part-task training. Generic Microcomputer Part Task Trainer (MPTT) prototypes will serve as vehicles to test training effectiveness across a representative sample of training tasks/subtasks.

Anticipated Benefits: In a recent analysis conducted by the AFHRL Analysis and Evaluation Office, the estimated cost-benefit ratio achievable, assuming wide-scale application of SFTs across the Major Commands, was put at 15 to 1.

Expected Completion/Delivery: The delivery of the first generic MPTT for training-effectiveness testing to AFHRL is expected by March 1987.

Title: TECHNOLOGY FOR SPECIAL FUNCTION TRAINER REQUIREMENTS

AFHRL Contact: Bernell J. Edwards
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The Military Airlift Command (MAC) has expressed intense interest in the use of low-cost microelectronic systems as a means of reducing training costs. Technologies such as microcomputer graphics systems, coupled with state-of-the-art instructional methods, appear to have significant training cost-avoidance potential. This R&D will assist in determining the value of inexpensive desk-top devices for training aircrews to perform various aircrew procedural tasks. AFHRL is providing technical assistance to MAC in the form of instructional design consultation, software review and critique, and conduct of field evaluations of several experimental systems. One of the systems is being developed to train C-141 and C-5 aircrews in the operation of a new fuel savings advisory system being retrofitted to these aircraft. Another system is being developed to train procedural and computational skills of C-130 loadmaster personnel.

FY84 Milestones: During the second quarter, software development for Fuel Savings Advisory Systems (FSAS) trainer was accomplished. Software

development for the loadmaster trainer was done during the fourth quarter.

Utilization: The cost-avoidance potential of Special Function Trainers (SFTs) is thought to be greatest during the early phases of training because of the power to effect relatively higher levels of skill earlier in programs. This should facilitate greater aircrew performance during advanced phases when tasks are integrated during rehearsal of full missions.

Anticipated Benefits: The concept of "software families" for varieties of tasks using a single hardware configuration should prove feasible, with the likelihood that the costs of these training innovations can be quickly recovered by large-scale distribution of SFTs across programs.

Expected Completion/Delivery: Oct 85

Title: RADAR WARNING RECEIVER/ELECTRONIC COUNTERMEASURES PART-TASK TRAINER

AFHRL Contact: Garry H. Boyle
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: AFHRL developed a desktop trainer that simulates the common Radar Warning Receiver (RWR) System and electronic countermeasures (ECM)/chaff flare panel configurations. Training includes equipment operation, malfunction analysis, interpretation of RWR symbology, and optimum ECM responses. Student stimulus and response are by means of a color graphic monitor with touch-sensitive panel and appropriate audio. Training methodology is "see then do," i.e., immediately after each step of the training comes the interactive practice. The objective of the R&D was (a) develop a part-task trainer (PTT), based on microcomputer technology, which would introduce the Air Force to an extremely low-cost training capability; (b) provide demonstration of applied PTT designs in an area currently difficult to train (electronic combat training); and (c) provide a means for AFHRL to gather empirical data on PTT training effectiveness.

FY84 Milestones: During the third quarter, software development was completed for TAC, and the Tactical Air Warfare Center acceptance test was also completed. Research evaluation began at Luke AFB and a demonstration was given at the Interservice/Industry Training Equipment Conference (IITEC). The Air National Guard evaluation was initiated.

Utilization: The product developed in support of this R&D can now be fielded and used by the Tactical Air Command (TAC), Military Airlift Command (MAC), and the Air National Guard (ANG) communities to provide time/cost-effective ECM training. The ultimate results will enhance aircrew survivability.

Title: GENERIC THREAT RECOGNITION TRAINER

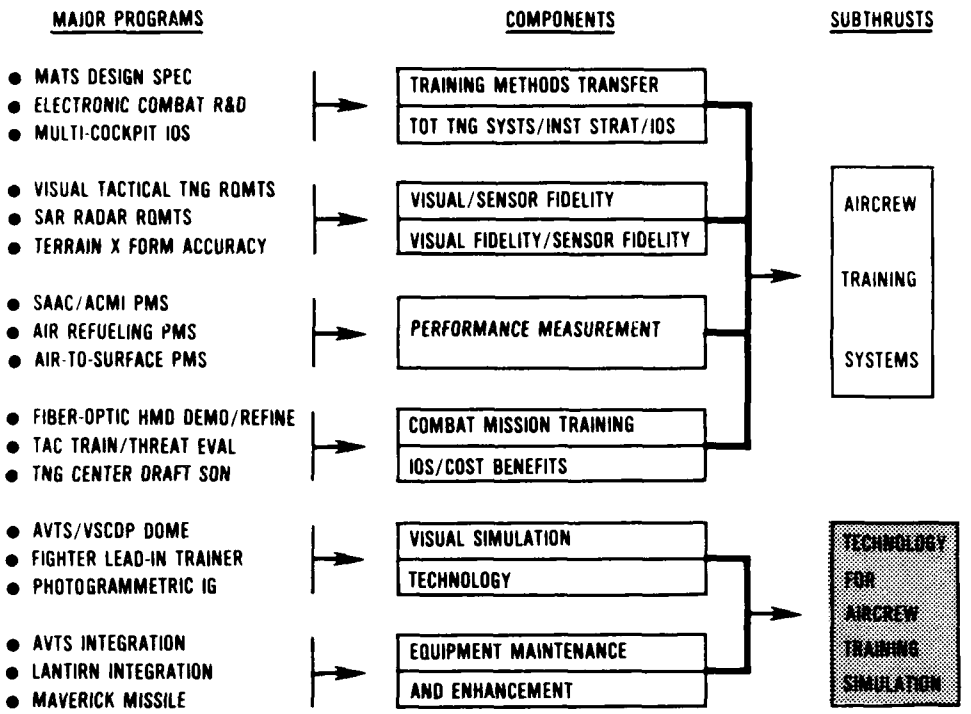
AFHRL Contact: Garry H. Boyle
AFHRL/OTA
Williams AFB, AZ 85240-6457
Commercial (602) 988-2611
AUTOVON 474-6561

Description: The Generic Threat Recognition Trainer provides the basic gaming elements of air-to-suface electronic combat in a compact desk-top system. The student pilot learns to identify and evade various enemy defenses while attempting to destroy ground targets. Variable terrain features, aircraft flight parameters, Radar Warning Receiver (RWR), and electronic countermeasure (ECM) effects are provided. User-friendly menus have been designed to allow the trainee to have the following options: (a) view an intelligence briefing prior to pass, (b) "fly" through an environment, (c) view the probability-of-kill graph of the last pass, (d) receive detailed briefings on individual threats, or (e) create a new environment. The most outstanding characteristic of the Generic Threat Recognition Trainer is that it is highly flexible. As requirements change, the system can be modified to accept new software and hardware and thus should provide relevant training for many years.

FY84 Milestones: Software development was completed and research evaluation was initiated.

Utilization: This capability will provide affordable training in threat recognition and avoidance at the operational squadron level for Tactical Air Forces personnel.

TECHNOLOGY FOR AIRCREW TRAINING SIMULATION



TECHNICAL ACHIEVEMENTS

Title: A-10 CLOSE-AIR-SUPPORT PERFORMANCE IN A FLIGHT SIMULATOR: EFFECTS OF VISUAL DISPLAY FIELD OF VIEW

AFHRL Contact: Ronald G. Hughes
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: A completed laboratory experiment addressed the suitability of currently available, limited field-of-view (FOV) visual display systems for simulator training applications, such as the Close-Air-Support (CAS) mission using the A-10 aircraft. In many respects, the A-10 CAS mission represents a worst-case application of a limited FOV system. Mission-qualified A-10 pilots rehearsed a single-ship, CAS mission in the A-10 configuration of the Advanced Simulator for Pilot Training (ASPT). A "central European" scenario provided for interactive target and threat arrays representative of those associated with the forward edge of the battle area.

First, 15 consecutive trials were flown under a large FOV display configuration (+110 by -40 degrees vertically by ± 150 degrees horizontally). Then 15 consecutive trials were then flown under a limited FOV display configuration (60 degrees vertically by 150 degrees horizontally). The limited FOV restriction resulted in a tendency to lose altitude in turns. An associated finding was a trend toward an increase in terrain impacts in the simulator.

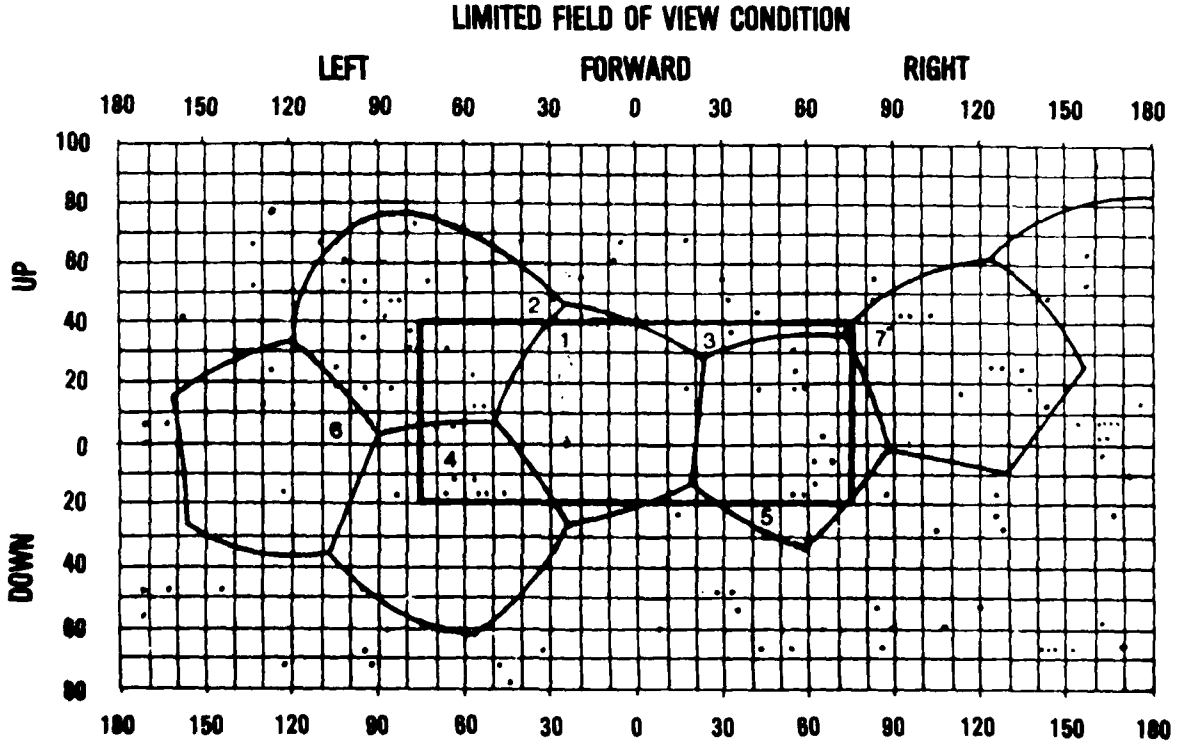
Offensively, the limited FOV display resulted in an approximate 20 percent decrease in "kills per attempt" and in "percent hits" compared to performances under the "large" FOV display baseline. Defensively, there was a three-fold increase in kills by the surface-to-air missile (SAM) threat under the limited FOV condition. This finding appears to have been related to a marked increase in missile launches behind the wing line and is suggestive of an increase in pilot workload for visually intensive tasks under conditions limiting out-of-cockpit field of view. These data are relevant to visual system requirements for tactical training

simulation, as well as for future sensor-based missions characterized by limitations to pilot field of view.

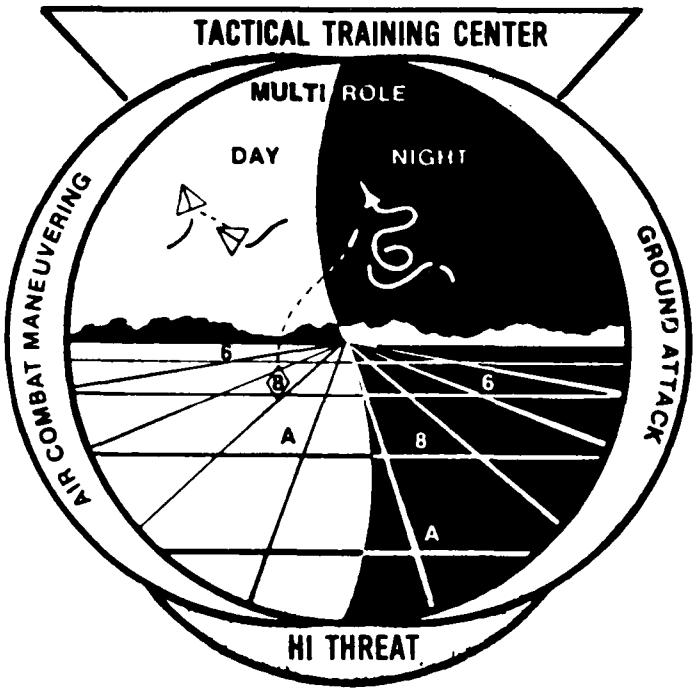
FY84 Milestones: This project was completed during the second quarter and the Technical Report prepared during the fourth quarter.

Utilization: The results serve to provide some degree of quantification to the training effectiveness issue regarding the relationship of tactical aircrew training to visual system design parameters. Although the research does not address training per se, it seems unlikely that, if a variable (in this case, FOV) is able to alter the baseline performances of trained operators, it would not also be found to affect the acquisition (i.e., the training) of that performance. To the extent that off-the-shelf visual display systems having limited FOVs might be sought for weapon systems having mission requirements similar to that of the A-10 CAS mission, these data suggest that both offensive and defensive aspects of the tasks, as practiced in the simulator, will be negatively affected. The empirical question as to whether such effects would also negatively impact subsequent operational performances remains to be determined.

Benefits: These data benefit the Air Force by providing information which serves to establish a boundary condition for the application of limited field-of-view display systems. From a methodological point of view, these data also strongly indicate the need for studies where performances under field-of-view limitations are directly observed rather than being inferred from target "migration" studies. Only through such direct observation were data collected suggesting that the field-of-view limitation may affect performance by way of affecting pilot workload for other visually intensive tasks performed in the cockpit.



TECHNOLOGY FOR AIRCREW TRAINING SIMULATION



Simulator Component of Integrated Training System

Title: THE TACTICAL TRAINING CENTER: AN INTEGRATION OF ADVANCED SIMULATOR AND RANGE SYSTEM CONCEPTS

AFHRL Contact: Ronald G. Hughes
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

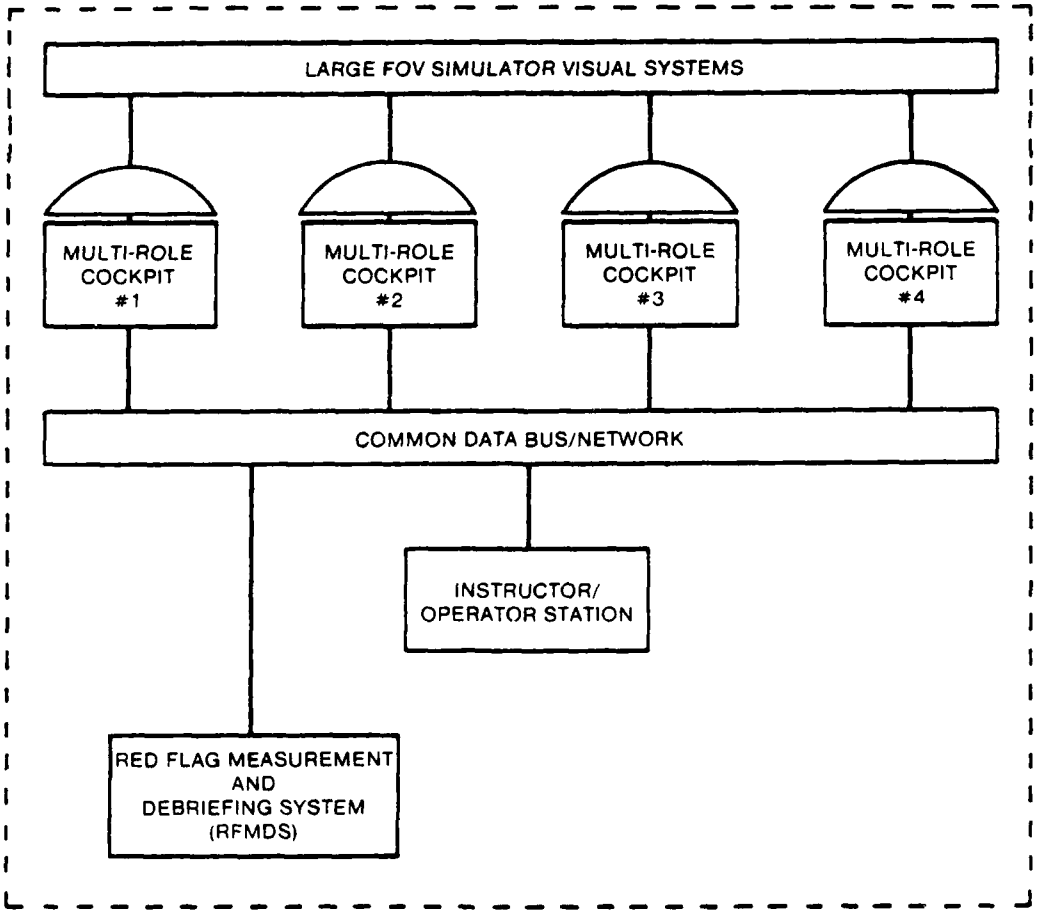
Description: A front-end concept analysis was performed which addressed the utility of a major new training concept involving the collocation and functional integration of a multi-cockpit flight simulator facility and a state-of-the-art instrumented range. The simulator component of the center concept is consistent with the Tactical Air Command (TAC) long-range concept for simulator training in the 1990s. The integration of the simulator component with the range component is the AFHRL contribution and is consistent with the AFHRL perception of long-range resource constraints with respect to advanced simulator and training range resources. A prototype center is projected for the late 1980s. The proposed center would establish a milestone for AFHRL for the transition of major R&D products in the areas of image generation, visual system display, and advanced Instructor Operator Station (IOS) design. Ideally, the actual development of the prototype center would be conducted by the Aeronautical Systems Division, Wright-Patterson AFB.

FY84 Milestones: A contract was awarded during the first quarter and the final report prepared during the fourth quarter.

Utilization: The concept study will provide focus for the Operations Training Division's engineering development efforts in the areas of image generation, visual display, and IOS design.

Benefits: The combined range and simulator training center will benefit the Air Force by making the most of the complementary aspects of advanced range and simulator assets. The center concept will be in direct support of the TAC notion of an expanded "schoolhouse" role, whereby much of the unit-level responsibility for advanced aircrew training will be transferred to the centralized training center. The Air Force will also benefit from the opportunity created by the center for the collection of training effectiveness data relevant to advanced simulator and range procurements. As such, the prototype center is expected to become a valuable Air Force resource comparable to the Army National Training Center. Both will represent crucial points of contact for the newly formed Training Data Analysis Center.

Range Component of Integrated Training System



Title: MULTIPLE-COCKPIT INSTRUCTOR OPERATOR STATION

AFHRL Contact: Ronald G. Hughes
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: An effort that was initiated during FY84 will result in a contract for the functional design of an Instructor Operator Station (IOS) able to support the operation of an advanced four-cockpit flight simulator device. The design of the IOS will be based on modularity design principles being developed by the Air Force Deputy for Simulators (ASD/YW). The IOS will make use of embedded simulation models for essentially "simulating the simulator." The embedded simulation capability will make possible the stand-alone use of the device for operator training, as well as use as an elementary tactics trainer. The multiple-cockpit IOS is being designed as a modular, stand-alone device that will be able to interface with the interactive dome/helmet display configuration being developed in-house as an engineering concept demonstration for the Combat Mission Trainer (CMT).

FY84 Milestones: Source selection was made during the fourth quarter.

Utilization: The design and development of an advanced IOS will meet an otherwise serious shortfall in the development of advanced simulator concepts. Too, with the anticipated integration of simulator and range (e.g., the training center concept), the IOS becomes an important bridge between operator, instructor, student, and exercise.

Anticipated Benefits: By approaching the design of the IOS from the standpoint of its central role in a projected integrated simulator/range training "center," critical man-machine and operator-exercise issues are addressed that are necessary to produce "user-friendly" consoles. By insisting upon modularity in the design of the IOS, significant design and cost efficiencies are expected that can potentially have far-reaching impacts on future procurements.

Title: PHOTO-BASED VISUAL SYSTEM

AFHRL Contact: Capt George Hept
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: An investigation was conducted into the application of photogrammetric manipulation techniques to visual flight simulation for training scenarios requiring high scene content and realism. The objective is to obtain a prototype photo-based image generation system for use in training evaluations against alternative computer image generation (CIG) systems.

FY84 Milestones: Work was completed by the contractor concerning the feasibility for incorporating variable acuity into a photo-based visual system. This was determined to be too high risk at the current time. A new-start contract was initiated to procure a photo-based visual system on a competitive basis for delivery early in FY89.

Utilization: The successful development and integration of this technology could represent a major advance in visual simulation. The high scene content inherent in this approach will provide realistic simulation of real-world tactical environments.

Anticipated Benefits: A photo-based visual system may enable a major advance in terms of visual scene detail and realism in comparison with typical CIG systems. Especially notable is the potential for simulation of high speed, low level, ground attack missions.

Expected Completion/Delivery: A photo-based visual system should be delivered early in FY89.

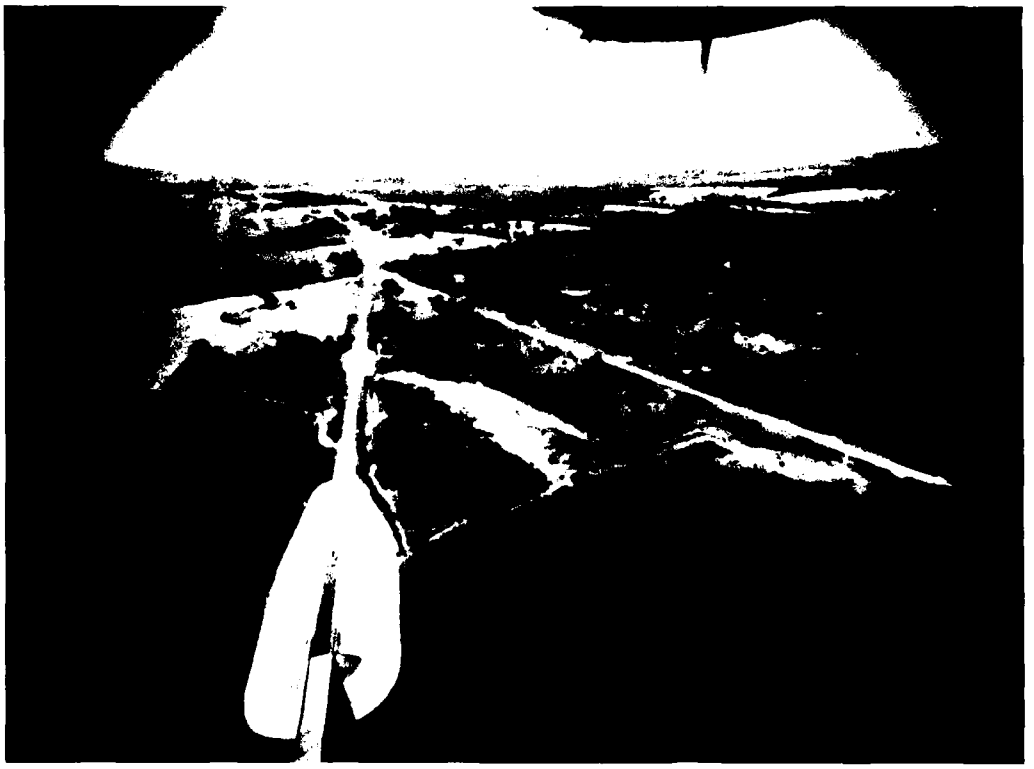


Photo from Low-Level Route for Videodisc Database

Significant Breakthrough in Display Technology

Title: FIBER-OPTIC HELMET-MOUNTED DISPLAY

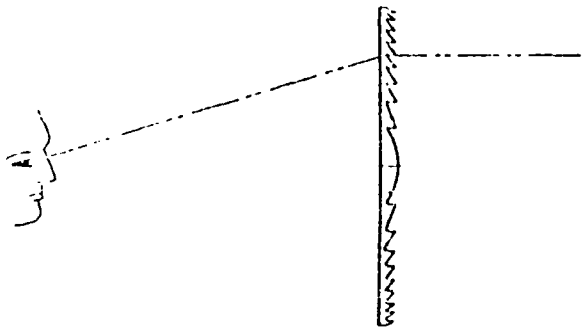
AFHRL Contact: Thomas M. Longridge
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: The fiber-optic helmet-mounted display (FOHMD) program is currently the only DoD-sponsored display system that can provide the color, high-brightness, high-resolution, and wide field-of-view display required for advanced tactical air-to-air and air-to-ground training R&D in a timely and affordable manner. This system uses coherent fiber-optic bundles to pipe imagery from high-brightness color projectors to a helmet display which has a large, head-slaved background area with a central high-resolution inset. Helmet accelerometers are utilized to provide the lead prediction necessary to compensate for computer image generator transport delays. A Phase II refinement effort will allow a reduction from four to two fiber-optic bundles, as well as a reduction in the size and weight of the entire helmet system. An optical head-tracker providing high dynamic accuracy will also be incorporated. Phase III of this effort will develop and implement an eye-slaved, high-resolution inset capability.

FY84 Milestones: Scientists experimentally established optimum binocular overlap, and determined effects of alternate high-resolution insert sizes. Feasibility of video blending for inset boundaries was determined. Optical head tracking system was developed and tested and an engineering design for a follow-on head-slaved prototype was created.

Utilization: The performance of the FOHMD will provide a previously unavailable capability to train in a full-field-of-view flight simulator. Unlike current conventional displays, this system can take full advantage of the level-of-detail of state-of-the-art image generators, while providing luminance levels brighter than those of any other existing display device.

Anticipated Benefits: The FOHMD will provide a significant breakthrough in display technology. It will permit presentation of detailed imagery at realistic ranges and luminance levels for support of advanced air-to-ground and air-to-air tactical training.



Fresnel Lens Schematic

Title: FRESNEL LENS APPLICATIONS TO FLIGHT SIMULATOR VISUAL DISPLAY SYSTEMS

AFHRL Contact: Capt George Hept
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

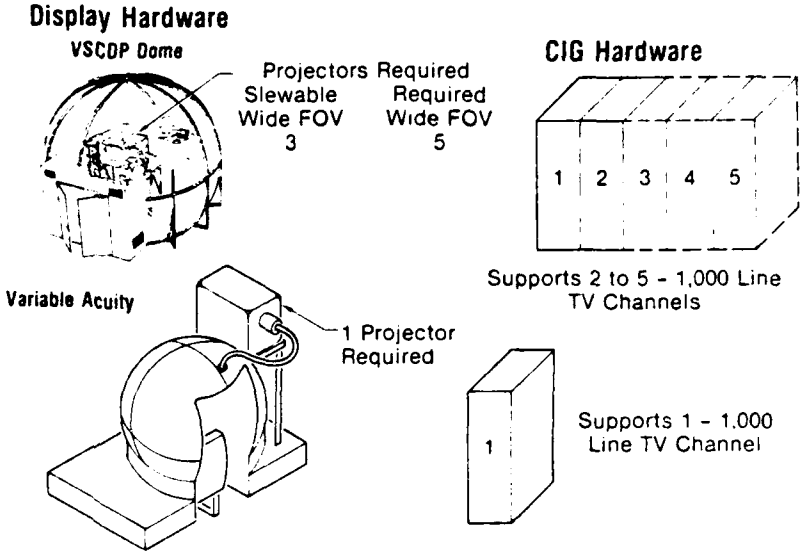
Description: Flight simulation visual systems employ a variety of display technologies. The most generally useful device is the cathode-ray tube (CRT), which suffers the deficiency that its light output is limited. This deficiency is compounded in many simulator applications by the need for collimating optical systems that result in light loss of up to 99%.

This effort is investigating the development of a light-weight, virtual-image, display system, consisting of collimating plastic Fresnel lenses that should enable light transmission of 75% rather than the present light transmission of 1% in the Advanced Simulator for Pilot Training.

FY84 Milestones: An evaluation model is being completed, and subsequent efforts are dependent on the results of the evaluation of the model projected production costs.

Utilization: This effort will develop a compact, virtual-image device which converts a CRT real image into a virtual image such that the scene appears to be at real-world distances (collimation) with minimum loss of brightness.

Anticipated Benefits: High-brightness infinity or virtual image displays may allow effective



Hardware Comparisons for Equal Visual Capability

training of tactical flight scenarios not now possible in a simulator.

Expected Completion/Delivery: This project is currently unfunded pending the progress of display devices not requiring the use of CRTs.

Title: VARIABLE ACUITY PROJECTOR

AFHRL Contact: Capt Larry Brown
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

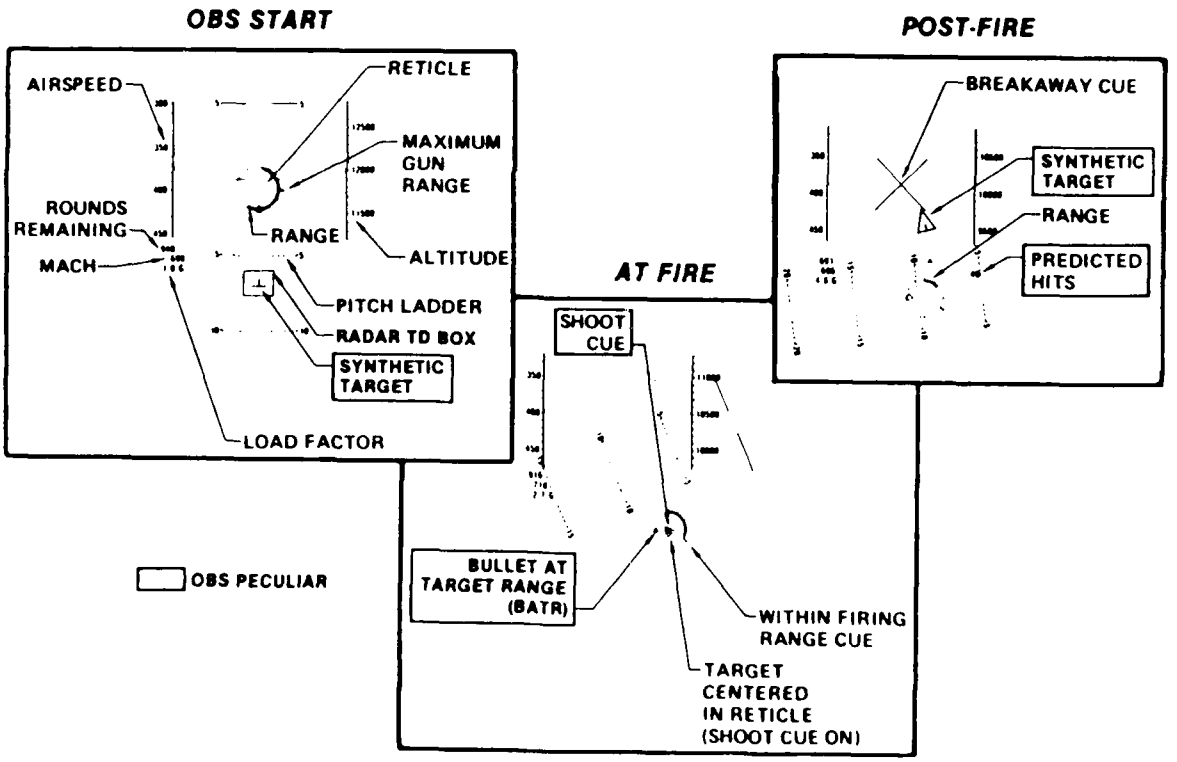
Description: The Variable Acuity Projection Program will provide a high-resolution, wide FOV, color visual system for application to tactical training simulators. Central to the variable acuity projection system is an eye-slaved projector lens that produces an image with a high acuity effect near the center FOV at the expense of peripher detail. When the viewer's eye is aligned with the projector's optical axis, a 160-degree display is seen and appears to be of continuous high resolution due to the characteristics of human eye perception. Generation of the entire visual field would be accomplished with a single video channel piped to the variable acuity lens and projected onto a 10-foot-diameter dome. The projection unit

receiving information from the eye-tracker will be slewable in any direction, giving the visual system a slewable full field-of-view.

FY84 Milestones: During FY84 AFHRL scientists modified an experimental test facility for eye tracker evaluations, determined projector servo-lag tolerance, investigated psychophysical effects of video blanking during servo transit interval, and estabished optimum techniques to correct frame delay and light-valve persistence.

Utilization: A variable acuity visual system will provide an alternative transportable visual display system. Generation of the entire visual field will be accomplished with a single video channel rather than several. In conjunction with an eye-tracking device, the 160-degree instantaneous FOV would require no more projection capability than does a single conventional 525-line display. A proposal has been initiated that would combine the present variable acuity visual system under design with resources available at the AFHRL Operations Training Division for use by the Fighter Lead-In Training course at Holloman AFB. The transfer would occur following an engineering evaluation of the visual system in early 1987.

Anticipated Benefits: The variable acuity visual system will provide the FOV and the level-of-detail required for tactical training of aerial and surface attack scenarios. If the variable acuity projection system proves to demonstrate desired performance, then the system would be well suited for combat mission trainers at the tactical unit level.



Onboard Target Simulation

TECHNOLOGY FOR AIRCREW TRAINING SIMULATION

Title: ONBOARD SIMULATION AND EMBEDDED TRAINING SYSTEM CONCEPTS

AFHRL Contact: Ronald G. Hughes
AFHRL/OTU
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: During the fourth quarter of FY84, the Operations Training Division, in conjunction with the Air Force Flight Dynamics Laboratory, initiated a contract R&D effort to build on the existing onboard simulation (OBS) capability for the F-15 Integrated Flight and Fire Control (IFFC) system. The current F-15 IFFC system has an embedded, or onboard, capability for presenting, in flight, all relevant cues for the conduct of gun, missile, and bomb deliveries. Onboard capabilities arrange for all relative aircraft and target geometries, as well as for the actual display of a single target aircraft on the pilot's heads-up display (HUD). The present effort will build on the existing capability through the integration of a helmet display into the actual aircraft. Use of the helmet display will permit the rehearsal of all-aspect, multiple-target engagements. Under this initial contract effort, critical issues for integration and use of the helmet display for this purpose will be evaluated in the simulator. Future efforts will evaluate the concept in actual flight tests.

FY84 Milestones: Contract award was made during the fourth quarter.

Utilization: Integration of the helmet display will build on current F-15 IFFC/OBS capabilities, which have already been effectively demonstrated through flight test to have significant training potential. The use of the helmet display in the manner described is expected to significantly extend this capability. AFHRL has initiated plans to pursue extensions of this work with the expectation of impacting the design of the Advanced Tactical Fighter.

Anticipated Benefits: Onboard simulation and embedded training represent efforts to provide effective unit-level training capabilities for such advanced aircraft as the F-15E (the Dual-Role Fighter), advanced versions of the F-16, and the Advanced Tactical Fighter. These unit-level capabilities are vitally needed as the Air Force seeks to support a highly mobile and dispersed fighting capability in the 1990s.

Non-Real-Time Perspective Display from Database

Title: PERSPECTIVE VISUAL SCENE GENERATION FROM DEFENSE MAPPING AGENCY DATABASE

AFHRL Contact: Capt George Hapt
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: An investigation was conducted into the applicability of the digital map generation technology to real-time generation of perspective views for simulator visual displays.

FY84 Milestones: A Digital Perspective Generator (DPG) demonstration breadboard was developed and subsequently evaluated late in CY84. The DPG breadboard successfully generated monochrome terrain data at 60 Hz. The most

notable accomplishments were the solution to near field-of-view "pixel blockiness" and the addition of sun-angle shading and hardware texture patterns. A "new start" competitive contract was initiated to follow up on these accomplishments.

Utilization: Digital map generation developments have incorporated techniques to display compressed digitized Defense Mapping Agency (DMA) terrain data, in planview formats, for onboard navigational use. The same compression techniques may also make it possible to cover a large gaming area and produce an out-the-window real-time visual display for flight simulation.

Anticipated Benefits: This effort is developing a means of providing a simulator visual image generator from existing DMA databases at a substantially reduced cost over conventional hand-modeled databases. This technology could also be expanded to produce transportable low-recurring-cost simulators.

Expected Completion/Delivery: A single-channel prototype will be evaluated in FY87.

Title: *ANALYSIS OF IMAGERY FOR MANIPULATION*

AFHRL Contact: Herbert H. Bell
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: In response to a request from the Air Force Aeronautical Systems Division, the AFHRL Operations Training Division has proposed the Analysis of Imagery for Manipulation (AIM) program to help determine the imagery requirements for future radar simulation systems. New high-resolution radars currently being integrated into such aircraft as the F-15, F-16, and B-1B pose a serious problem for radar simulation because of their increased ground-resolution capability. In order to help determine the ground-resolution and image-fidelity requirements for the simulation of such radars, the AIM program will selectively alter the characteristics of both actual and simulated radar imagery through the use of digital image processing technology. Examples of the image variables that will be manipulated in this program include range resolution, field of view, and the number of internal edges presented. Performance assessments and transfer-of-training R&D will be conducted with various levels of this imagery, to identify critical image requirements.

FY84 Milestones: A contract was awarded for Digital Image Processor development to be used in the AIM program. The Advanced Visual Technology System Solid Crystal Light Valve was delivered and engineering assessments completed. The first six channels of the computer image generator were delivered and integrated with the F-16. Data collection began using the prototype fiber-optic helmet-mounted display.

Utilization: The results of this effort will be used by the Aeronautical Systems Division to develop specifications for future radar simulation systems.

Anticipated Benefits: This R&D effort will help define cost-effective radar simulation system requirements for aircrew training.

Expected Completion/Delivery: Third Quarter FY87.

Title: INVESTIGATION OF REAL IMAGERY VERSUS COLLIMATED IMAGERY IN A FLIGHT SIMULATOR VISUAL DISPLAY

AFHRL Contact: Robert R. Woodruff
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial (602) 988-6561
AUTOVON 474-6561

Description: Data analysis has been completed to determine if there are performance differences among pilots accomplishing straight-in landing in a flight simulator equipped with either a collimated or a real-image display. Two landing sequences were investigated with each display: either rich or austere imagery. This R&D was conducted in the Operations Training Division's VIGOR facility, which consists of an F-111 aircraft Digital Image Generator System, a T-38 aircraft cockpit, 32/55 SEL computers, and a WAC window display. For this project, a real-image display was incorporated in the facility. This consisted of rear-projection screens and color light-valve projectors.

AD-A156 918 AIR FORCE HUMAN RESOURCES LABORATORY ANNUAL REPORT FY84 1/3
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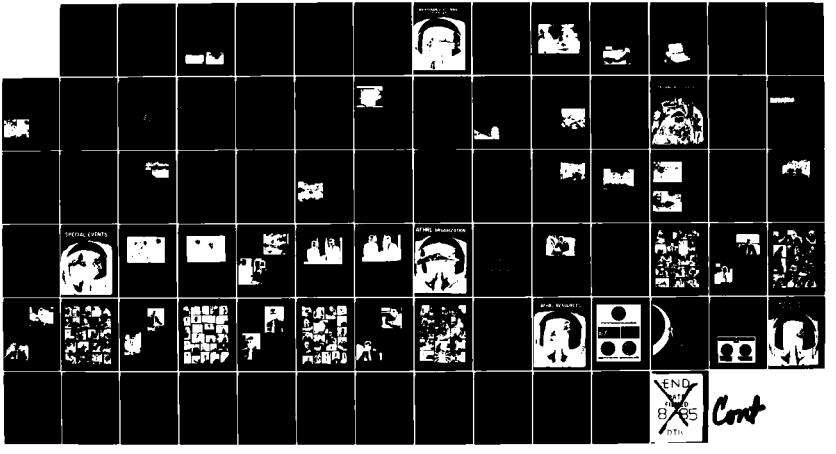

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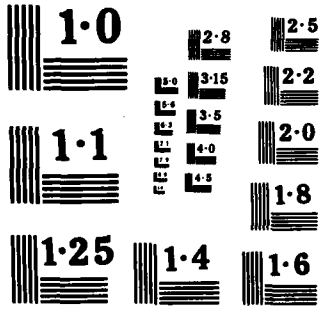
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Brightness, contrast, resolution, and pilot eye-to-display distance (1 meter) were controlled in the two conditions.

FY84 Milestones: The experimental design and equipment modification were completed in the third quarter. Data collection and data analysis were completed in the fourth quarter.

Utilization: Six dependent measures of performance were made at touchdown: airspeed, vertical velocity indication, distance from threshold, and centerline deviation. Distance from threshold at the beginning of descent and average glideslope deviation were also measured. Statistically significant multivariate effects were found between the displays and between the imagery environments. Interactions were not significant. Measures which contributed to the difference between displays were airspeed and glideslope deviation. Airspeed at touchdown was 4 knots below the desired 155 knots with the real-image display and was correct with the virtual image display. Only airspeed differed significantly between the imagery environments. These findings suggest that simulator training of the landing task with real imagery located 1 meter from the pilot's eye may be feasible. If this finding is confirmed and shown to apply to a wide variety of tasks, future simulators may be more compact and cheaper than is now the case.

Title: LOW-ALTITUDE NAVIGATION AND TARGETING INFRARED NIGHT SYSTEM

AFHRL Contact: Ms Rebecca Brooks
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commercial: (602) 988-6561
AUTOVON: 474-6561

Description: An F-16 Low-Altitude Navigation and Targeting Infrared Night (LANTIRN) full-mission simulator is currently under development at the AFHRL Operations Training Division. LANTIRN will provide the F-16 aircraft with day or night, under-the-weather, low-level strike capability. A navigation pod, a targeting pod, and a wide-field-of-view, holographic, heads-up-display, or HUD, make up the LANTIRN system. The HUD displays video from the navigation forward-looking infrared sensor, as well as flight symbology. This allows the pilot to fly night missions heads up just as is done during the day.

The LANTIRN simulator will have a full-field-of-view visual display, along with radar and infrared (IR) sensors. Databases include the Nevada Red Flag ranges and a foreign environment. Both LANTIRN databases include a variety of targets and threats appropriate to combat environments.

FY84 Milestones: The draft syllabus of the F-16 LANTIRN simulator training course was completed. Database content was specified for the Nevada and foreign LANTIRN databases. LANTIRN simulator training start date was rescheduled from October 1985 to October 1988.

Utilization: The F-16 LANTIRN full-mission simulator will be used for interim training by the Tactical Air Command (TAC) and for training research in areas such as sensor-based night attack, pilot workload, etc.

Anticipated Benefits: Interim aircrew training will be provided for TAC during the critical period before training devices become available in FY89. In addition, AFHRL will have a testbed for studying sensor simulation, pilot workload, sensor-based night attack, etc.

Expected Completion/Delivery: Initial operation October 1985; full capability October 1986.

Title: ADVANCED VISUAL TECHNOLOGY SYSTEM

AFHRL Contact: Herbert H. Bell
AFHRL/OTE
Williams AFB, AZ 85240-6457
Commerical (602) 988-6561
AUTOVON 474-6561

Description: The computer image generation (CIG) being developed under the Advanced Visual Technology System (AVTS) project is designed to provide visual "out-the-window" imagery for the full spectrum of tactical air missions. This includes air-to-surface weapons delivery, low-level flight, acquisition of surface-to-air missiles, and evasive maneuvers. Air-to-air combat is simulated, providing options of 1 vs 1, 2 vs 1, and 2 vs 2. Normal flight operations such as takeoff, landing, and aerial refueling can be performed.

The CIG will be compatible with different types of display systems, including the F-16 aircraft

seven-window dodecahedron and the new 30-foot AH-64 helicopter dome. It will provide high-quality, very realistic imagery for combat simulation. A new contractor development called "cell texturing" will allow for greater scene detail. It offers significant improvement over conventional texturing and results in near-photographic-quality, fully interactive computer generated imagery. This cell texturing, combined with other CIG features such as surface texturing and circular features, will provide very realistic nap-of-the-earth flight simulation for Air Force and Army aircraft. Other CIG features are moving models, weapons effects, and full color. Image quality improvement is done through oversampling, which eliminates streaks, staircasing, and terrain zipper effects. A data processing technique, called area processing, reduces the amount of computer hardware required and overcomes the edgecrossing limit of current CIG systems.

Another part of the AVTS is the Visual System Component Development Program. This is an Army-funded visual R&D program that will lead to a production contract for a visual system for the AH-64 helicopter. The AFHRL CIG will be modified to increase its capabilities and to make it compatible with new display systems. Modifications will include:

1. A multiple-viewpoint capability will be added to permit the system to portray multiple-ship combat engagements for tactics research and evaluation.

2. The capability for distortion correction will be added to allow the CIG to be used with displays other than mosaic cathode-ray tubes.

3. Four of 10 channels will be modified with state-of-the-art technology to provide real-time cell-texturing capability. This feature provides realistic, high-detail imagery for low-level flight.

4. An infrared sensor capability will be added to two channels of the CIG. This will enable the CIG to be used for both combat mission training and development of the Low-Altitude Navigation and Targeting Infrared Night attack system.

The program also includes the development of a wide-field-of-view dome color display. This system will use optical inset blending and eye/head tracking to provide a high-resolution, high-quality display image.

Another technology accomplishment is the development of an Advanced Solid Crystal Light Valve projector for use in simulator displays.

An increase in image brightness of 2.3 times was achieved over the best, currently available light-valve projectors. This increase in brightness will allow trade-offs in display design and result in improved simulator displays.

Utilization: The new CIG will be a powerful tool for determining training effectiveness in a wide-field-of-view simulator. Integration of the dome display and the modified CIG will create an advanced display system capable of training such tasks as air-to-ground combat and nap-of-the-earth flight.

Visual Simulation of Low-Altitude Environments

OPERATIONS TRAINING DIVISION R&D PRODUCTS

1. The Tactical Training Complex: An Integration of Advanced Simulator and Range System Concepts. A concept was investigated whereby the first prototype of a multiple cockpit aircrew training device would be collocated with an advanced, instrumented range capability. The rationale of such an integrated complex was examined, as well as arguments for its training and cost effectiveness. Such a complex would represent a major technology transition effort in the early to mid 1990s.

2. A-10 Aircraft Close-Air-Support (CAS) Performance in a Flight Simulator: Effects of Visual Display Field of View. An experimental study was completed which documented the effects of out-of-cockpit field-of-view (FOV) limitations on both the offensive and defensive aspects of A-10 CAS performance in a flight simulator. The A-10 CAS mission represents a worst possible case application of a limited FOV visual system; therefore, the present data serve to establish a boundary condition on the effects of such applications.

3. On-Board Simulation and Embedded Training Systems Concepts. A contract effort is currently underway between the AFHRL Operations Training Division and the Air Force Flight Dynamics Laboratory to investigate enhancements to the existing F-15 Integrated Flight Fire Control (IFFC) onboard simulation capability. The effort involves the in-flight application of helmet display technology for training applications. Limited simulator trials of these concepts are planned for the third quarter FY85.

4. Multiple Cockpit Instructor Operator Station. An R&D contract effort was initiated for the functional design of a multiple cockpit Instructor Operator Station (IOS). The one year effort will be followed by a competitive solicitation for the actual development of the device and for its integration with in-house facilities at the AFHRL Operations Training Division.

5. A Unitary Measure of Performance for the Close-Air-Support Mission. A composite measure of A-10 pilot performance for the close-air-support mission in the Advanced Simulator for Pilot Training (ASPT) was formulated and validated using judgments of mission-ready A-10 pilots. The performance measure can serve as a criterion measure to evaluate alternative training strategies used in ASPT.

6. Model Aircrew Training System (MATS). MATS is a restructuring of aircrew training to apply state-of-the-art training technology and practices. The C-130 weapon system was selected for this program, which will be used to address general training system design issues. The goal is to develop a model training system that can be applied to other weapon systems.

7. C-130 Weapon System Trainer (WST) Operational Test and Evaluation (OT&E). Training effectiveness of the C-130 WST was evaluated with primary focus being on how the visual system impacted transfer of training. Transfer from the WST to the aircraft was determined for initial qualification, mission qualification, and continuation training.

8. Performance Measurement System (PMS) Guidelines for Aircrew Training Devices (ATDs). The final product will be a handbook incorporating design guidelines to aid in the specification of instructional support features for simulators. It is intended to provide a standardized set of definitions for training features and to enable a standardized means of preparing functional design specifications. The primary users will be the Major Commands, which must define functional requirements, and the Simulator Systems Program Office which must prepare the actual specification.

9. Air Combat Measurement System for the Simulator for Air-to-Air Combat (SAAC) and Air Combat Maneuvering Instrumentation (ACMI). The final product will be a facility for the conduct of air combat maneuvering performance measurement R&D. For AFHRL, it will enable the development and testing of new scoring algorithms, as well as graphic concepts for displaying ACM engagements. It will also provide the necessary tolls for the conduct of R&D within the ACM training environment at Luke AFB. For the Tactical Air Command (TAC), it will provide a graphic replay capability which can be used in support of the TAC ACES training program conducted in the SAAC.

10. C-5A Performance Measurement System. The final product is a prototype instructional support system attached to the C5-A flight

simulator at Altus AFB. It will enable the test of advanced instructional features within an operational training environment. The results of the evaluation will be transitioned to the Simulator Systems Program Office for inclusion in subsequent acquisitions of aircrew training devices.

11. Generic Threat Recognition Trainer. This microcomputer-based device provides gaming elements of air-to-surface combat in a compact package. It is potentially an affordable means of familiarizing pilots with the essentials of threat recognition and avoidance at the operational unit level.

12. Generic Special Function Trainer Prototypes. These experimental low-cost training devices are intended as technology demonstrations for the Major Commands. Generic trainers will make use of a common set of hardware and specific software depending on training tasks.

13. Aircrew Training Task Surveys. Operations Training Division is collecting opinion data from operational aircrews among the Major Commands concerning the potential of low-cost technology for training selected aspects of mission related tasks. Survey data will be used to develop new methods of part-task training.

14. Technology for Special Function Trainer Requirements. New methodologies are being developed to provide the means for matching task characteristics with part-task training methods. This research involves the use of mathematical modeling of aircrew tasks.

15. Radar Warning Receiver/Electronic Countermeasures Part-Task Trainer. Empirical data show this inexpensive part-task trainer is more effective than are conventional syllabus methods for familiarizing aircrews in the basic skills of recognizing and countering enemy defense systems. The transfer of this technology for wide-scale application in operational unit training is in progress.

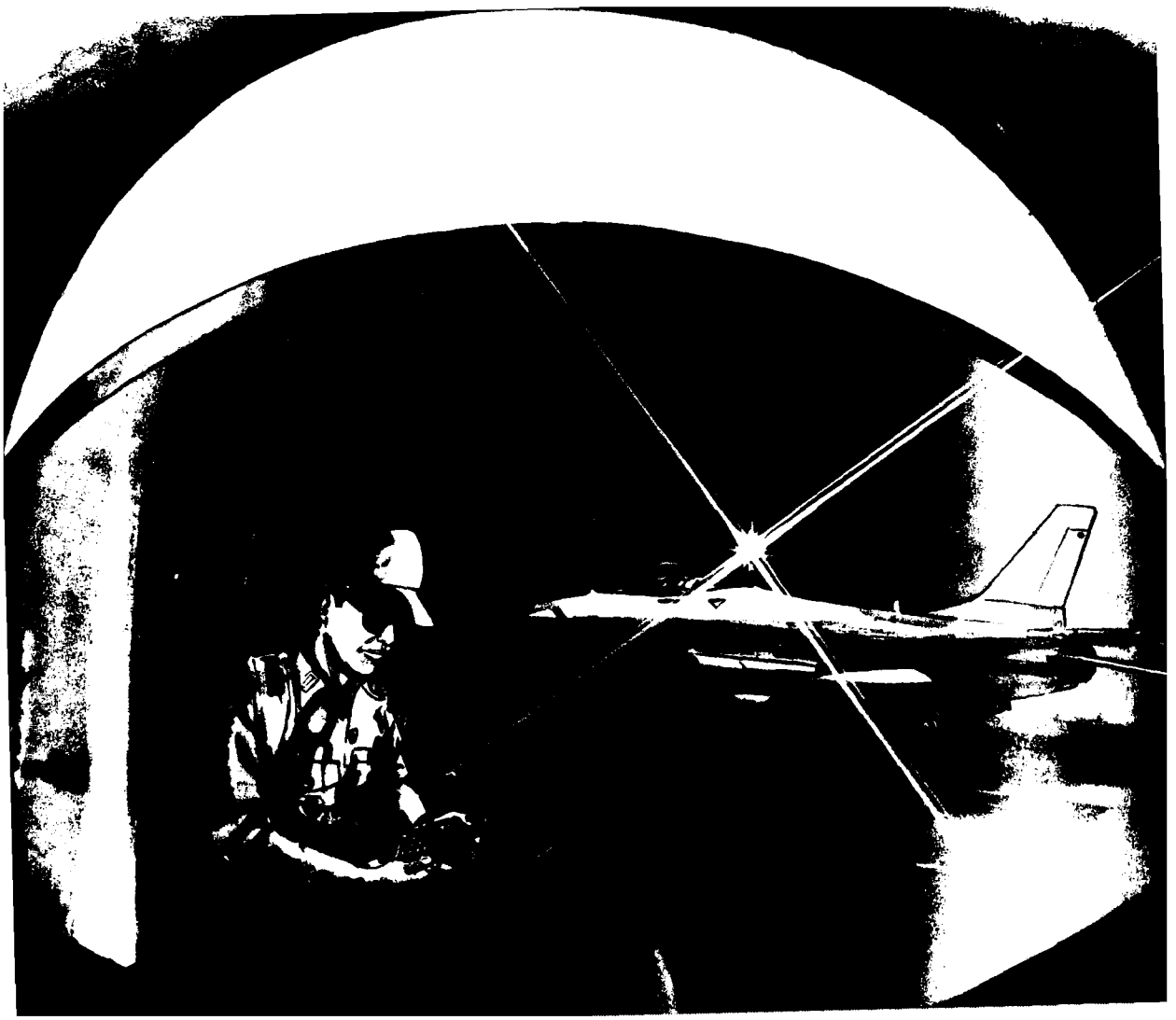
16. Advanced Visual Technology System. Project 2363 Computer Image Generator (CIG). Delivered hardware consists of approximately 40 cabinets of computer equipment and associated peripherals. This equipment is organized into three groups - a General Purpose Computer System (GPCS), a Special Purpose Computer System (SPCS), and a Database Management System (DBMS). The CPCS contains two mainframe SEL computers, which comprise the first section of a three frame pipeline processor. The second and third pipeline frames consist of custom designed equipment located in the SPCS. The DBMS consists of a Perkin Elmer Interdata 3230 computer, a Tektronix Digitizing Tablet, a Tektronix monitor, a Ramtek color display monitor, and other peripheral equipment. The DBMS equipment is designed to be extremely user friendly and may be used off line to create and modify the CIG database. The CIG is capable of providing 10 channels of high scene density out-the-window imagery. Each channel provides 1023 lines, 1000 pixels per line, 211 interlaced, at a 30 or 60 Hz, field update rate. An acceptance test was conducted following equipment delivery. Equipment is currently under modification for the Visual System Component Development Program (VSCDP) to support special texturing, curved surface projection, and infrared sensor simulation.

17. Digital Perspective Generator (DPG): In an AFHRL/OT funded project, the contractor completed work on a "Proof-of-Concept" design of a *low-cost, transportable image generator.* The DPG, in its current form, is capable of generating perspective (out-the-window), monochrome, visual scenes with simple ground texture patterns. The scene is derived from Defense Mapping Agency terrain data and it can be "flown" through in real-time with a joystick controller.

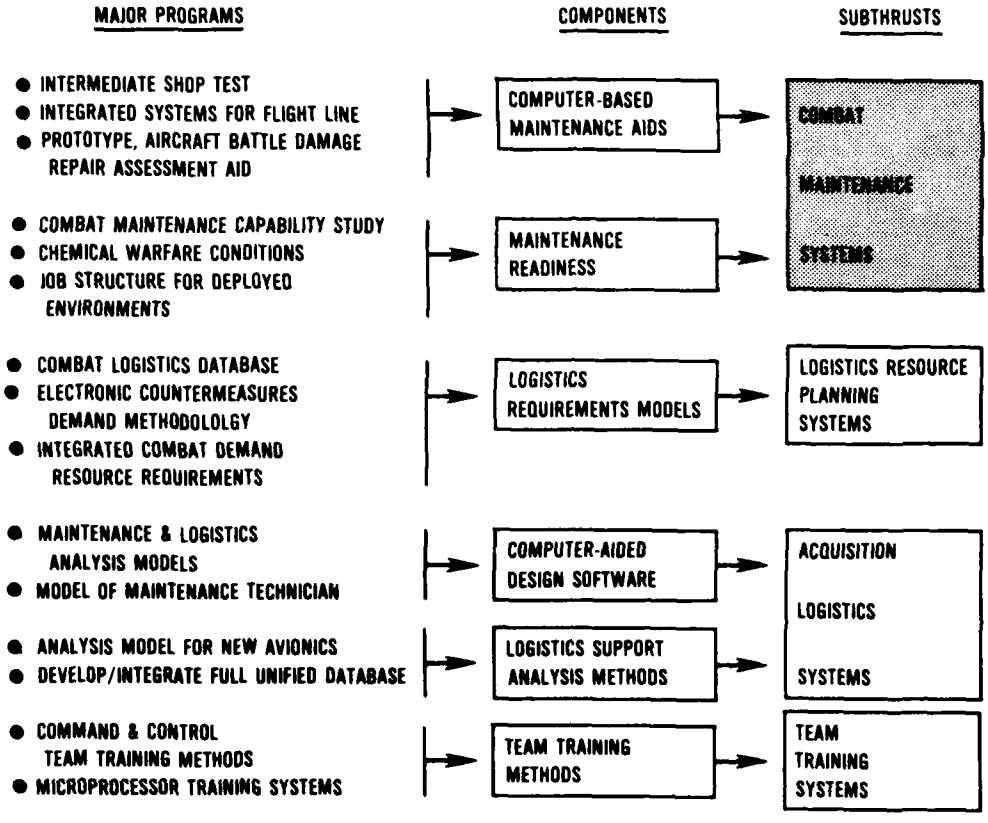
18. Advanced Visual Technology System, Project 2363: This advanced computer image generation and display system was developed to support training effectiveness research for the Tactical Air Command and the U.S. Army. During FY84, the first six channels of the computer image generator, a database development system, and a prototype solid crystal light valve were accepted by AFHRL/OT. Engineering evaluations are presently in progress to assess the capabilities of these items. During FY85, the remaining four channels of the computer image generator and a unique head/eye tracked dome display system will be delivered to AFHRL/OT. After system integration and engineering evaluations, the components developed under this

project will be used to define simulation hardware and training requirements for both fixed and rotary wing fighter/attack aircraft. Much of the technology developed under this project 2363 has already been transitioned to computer image generation systems now under commercial development.

19. Advanced Simulator Concepts, Project 2743 Products: Design criteria for head- and eye-coupled flight simulation visual systems. Wide field-of-view, high resolution, full color, high brightness helmet-mounted display system for advanced air-to-air and air-to-ground combat training. Hard data on the training effectiveness of a fiber-optic, helmet-mounted display system for air combat training.



MAINTENANCE AND COMBAT SUPPORT THRUST



COMBAT MAINTENANCE SYSTEMS — ONGOING R&D

Title: COMBAT MAINTENANCE CAPABILITY

AFHRL Contact: Richard E. Weimer
AFHRL/LRC
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-2606
AUTOVON 785-2606

Description: The Air Force lacks realistic measures of the capability of peacetime units to successfully perform maintenance or logistics support roles in a combat environment. Current capability indicators are mostly subjective in nature. Peacetime sortie surge exercises demonstrate mission capable rates under peacetime conditions, but the impact of combat conditions on that sortie rate is not known. The difference between peacetime and wartime spares requirements is not fully known or understood. The objective of this effort is to examine systematically and critically the differences between peacetime and combat maintenance processes.

A wartime scenario was developed at Hahn AFB, Germany, to describe wing operation in wartime. Various modeling techniques were reviewed and three (TSAR, TSARINA, and DYNAMETRIC) were selected to provide optimal determination of logistics composites, theater airbase resources, and supply demands for wartime operations. An extensive data collection process included structured interviews and survey responses from F-16 maintenance personnel in the continental United States, the Pacific area, and Europe. Limited interviews were conducted with Vietnam combat-experienced maintenance personnel. Expert opinions were obtained on task-time requirements, both for peace and for wartime. Task differences due to a chemical warfare environment were also projected. These data were analyzed in a computer simulation to assess the impact of wartime tasks and resource levels on sortie capability.

FY84 Milestones: Field data collection efforts were completed, including observation of exercises at Hahn AFB, Germany.

Plans were formulated for program revision to include a validation study on F-111F aircraft during FY85 and FY86.

Utilization: The results of this effort will provide methodologies for analyzing the difference between peacetime and combat aircraft maintenance and the effects of this difference on sortie generation capability. The methodologies and simulation techniques employed will be effective in establishing a capability to simulate and analyze the composite effects of combat conditions.

Anticipated Benefits: The techniques can be used to better identify training requirements for combat tasks and to realistically assess the potential bottlenecks to sortie generation under combat conditions.

Expected Completion/Delivery: Final reports on the basic effort are due in February 1985. A field validation is planned to be complete by the third quarter of FY86.

Combat Maintenance Requirements Investigated

COMBAT MAINTENANCE SYSTEMS

Title: COMPUTER-BASED MAINTENANCE AIDS FOR TECHNICIANS

AFHRL Contact: David R. Gunning
AFHRL/LRC
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-2606
AUTOVON 785-2606

Description: A prototype computer-based maintenance aids system is being developed that will store, retrieve, and present information for use by technicians who perform maintenance tasks at the intermediate level. The goal is a system that is easy to use, is liked by technicians, and provides all the information needed for the task. Human factors requirements are being emphasized in the system design. The system will present instructions at three levels of detail. This feature will provide technicians with instructions that are appropriate for all levels of experience (very detailed instructions for inexperienced technicians, less detailed instructions for more experienced technicians). The prototype consists of a graphics terminal and a minicomputer installed at an intermediate-level aircraft maintenance shop at Offutt AFB, Nebraska, in November 1984. There, the prototype will be evaluated by measuring the effectiveness of technicians using the system in performing maintenance.

FY84 Milestones: Computer-based maintenance aids prototype designs were developed. The prototype was appraised and adjusted in preparation for field testing.

Utilization: The results of the evaluation will be used to develop system specifications for the procurement of technical data for future weapon systems. The prototype will be used in the demonstration of integrated maintenance aiding and diagnostics for the PAVE SPRINTER project and for the development of an automated technical data system for the Advanced Tactical Fighter. In addition, the technology developed in this project will provide the basis for developing an effective technical data presentation system for the Automated Technical Order System of the Air Force Logistics Command.

Anticipated Benefits: Better data tailored to individual skills will produce better maintenance. The clear, current, user-friendly automated maintenance instructions will allow new people to be productive sooner and will enable technicians to perform a wider range of tasks accurately.

Expected Completion/Delivery: Field tests of the prototype system should be complete in January 1985 and May 1985. System specifications will be delivered in June 1985.

Computer-Presented Maintenance Instructions

Title: PORTABLE COMPUTER-BASED MAINTENANCE AIDS SYSTEM

AFHRL Contact: Capt Stan Collins
AFHRL/LRC
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-2606
AUTOVON 785-2606

Description: A portable prototype system will be developed to present technical data for use at the organizational maintenance level in a flight-line environment. This lightweight system will be capable of storing, rapidly retrieving, and presenting routine maintenance data, fault isolation information, and aircraft battle damage repair assessment data (including complex graphics).

Each year the Air Force spends millions of dollars to develop, distribute, and update paper-based technical orders (TOs). The information is often incomplete and difficult to locate. Because of the similar requirements for displaying routine maintenance data and aircraft battle damage assessment (ABDA) data, the portable computer-based maintenance aids system is being developed as a general-purpose system that will eliminate duplication in R&D efforts, avoid the high costs of supporting two systems, and simplify training and familiarization requirements.

FY84 Milestones: The planning and contract Statement of Work preparation for a new work unit was initiated.

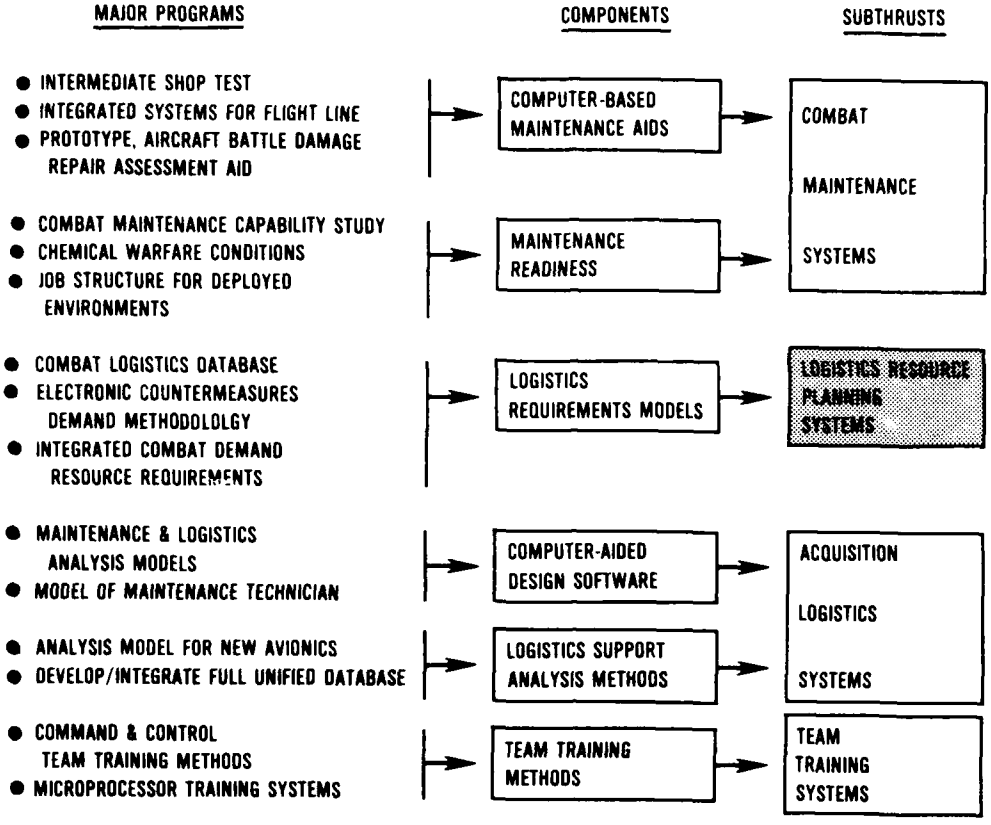
Utilization: This effort will develop (a) specifications for the system hardware and software and (b) content and format specifications for both the TO and the ABDA data.

Anticipated Benefits: This effort brings the benefits of maintenance instruction automation to the flight line. It is a direct follow-on to the development of computer-based maintenance aids described above. The portable, stand-alone electronic aids will improve mobility and capability for maintenance in deployed environments.

Expected Completion/Delivery: Draft specifications will be available for the portable computer and associated software, the TO content and formats, and the ABDA data by the end of FY88.

Computer-Aided Flight-Line Maintenance

LOGISTICS RESOURCE PLANNING SYSTEMS



ONGOING R&D

Title: WARTIME DEMAND RATES FOR AIRCRAFT ELECTRONIC COUNTERMEASURES EQUIPMENT

AFHRL Contact: Capt William M. Weaver
AFHRL/LRL
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-8418
AUTOVON 785-8418

Description: Because peacetime use of electronic countermeasures (ECM) equipment is limited, there is currently no thorough method to aid manpower and logistics specialists to plan support for wartime logistics requirements of aircraft ECM equipment. All available methods are based on peacetime operations and indicators, such as supply/demand rates, repair rates, and support factors. Subjective "best" estimates are, therefore, often used as input data, and this results in a low level of confidence in the requirements computation.

In an attempt to resolve these problems, several algorithms have been developed using strawman wartime demand rates. The end product will be computer software. Using this software, commands will be able to compute ECM parts wartime demand rates for specific scenarios that capture war, maintenance, and design-induced demands to support the ECM system.

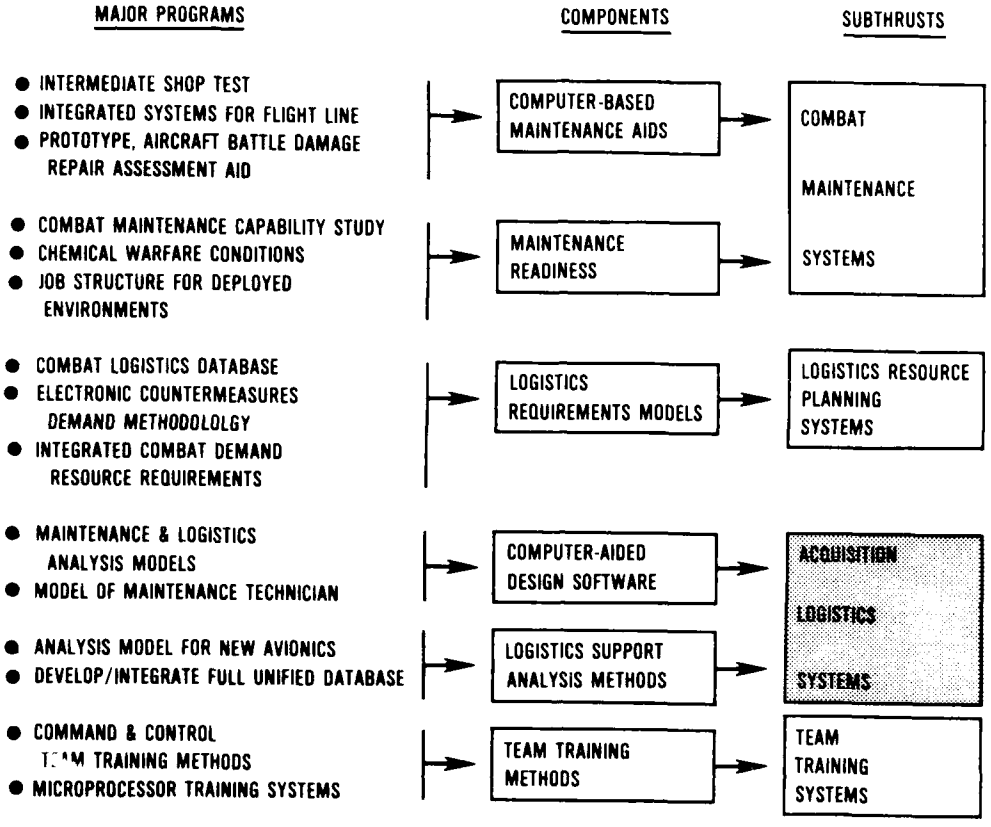
FY84 Milestones: A concept feasibility study was completed, and a contract work statement initiated for the development work.

Utilization: Products derived from this software forecast the ECM parts required for the War Readiness Spares Kit and the wartime component demand/failure rates for logistics assessment modeling.

Anticipated Benefits: The methods developed will aid Air Force manpower and logistics planning for wartime scenarios. With more accurate parts forecasting, the not-mission-capable supply rate for ECM parts will be reduced, resulting in improved operational effectiveness of ECM aircraft and a reduction in the attrition rate of ECM mission aircraft.

Expected Completion/Delivery: Sep 86

ACQUISITION LOGISTICS SYSTEMS



ONGOING R&D

Title: MAINTENANCE AND LOGISTICS FACTORS IN COMPUTER-AIDED DESIGN

AFHRL Contact: Alan E. Herner
AFHRL/LRA
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-3871
AUTOVON 785-3871

Description: Maintenance and Logistics Factors in Computer-Aided Design (MLCAD) is automation of early design analysis using computer-aided design (CAD) such that equipment does not break as often, and when it does break, it is easier to fix.

Two industry demonstrations are being conducted to give hard evidence of the application of MLCAD to early design. AFHRL is working with the Ground Launched Cruise Missile (GLCM) office to redesign the power generator for the erector-launcher. Accessibility and thermal analyses are being done using CAD equipment to improve the reliability and maintainability of the systems. The second demonstration is improving the testability of the Nuclear Remote Interface Unit on the F-16. CAD is being used to improve the coverage of testing by adding appropriate new test points.

These two short-term demonstrations are being accompanied by the development of the technical specifications for Reliability and Maintainability in CAD (RAMCAD). This development is being done by the Institute for Defense Analysis (IDA). To assure that the development is compatible with industry, the National Security Industrial Association has set up a 30-member advisory panel. AFHRL participation in the Joint Logistics Commanders (JLC) RAMCAD subpanel (Logistics R&D) ensures Tri-Service coordination.

ROTC Cadets on Graduation Day

graduate pilot and navigator training, technical training, Officer Effectiveness Report (OER) ratings, and continuation in the Air Force.

FY84 Milestones: Each fiscal year the investigation was forwarded to the requester as it was completed. The final product was completed by forwarding the sixth annual report early in October 1983. The sixth fiscal year report contained data for computing comparative statistics through September 1981. Six fiscal years of data were used to determine if those individuals who had a 6-year commitment made a decision to continue in or get out of the Air Force.

Utilization: This long-term effort will be used by AFROTC to assess the impact of MFSS graduates on the active duty force in terms of continuation in the Air Force and success in pilot, navigator, and technical training courses. Based on this assessment, a decision will be made whether to use a single screening factor, such as the Officer Quality Composite, or to continue operational use of a multiple factor screening system.

Benefits: The results from these six projects provide statistical data to Air Force management for policy decisions on the type of personnel allowed to be commissioned through ROTC and allowed to enter high cost pilot, navigator and technical training. Analysis of the statistics will support a direct comparison of officers who were commissioned under the MFSS and those who were commissioned under the standard procedure. An analysis of the statistics will shed light on the benefit and risks of enlarging the pool of eligibles during periods when recruitment of highly qualified officers is difficult.

Title: GENERAL PURPOSE PROGRAM DEVELOPMENT

AFHRL Contact: Charles R. Rogers
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The Technical Services Division develops, maintains, documents, and provides training in the use of general purpose computer software. This software includes the broad categories of (a) language translators, such as precompilers and interpreters, (b) utility programs, such as sort/merge and report writers, (c) applications programs, such as correlation-regression analysis and multi-dimensional frequency distributions, and (d) subroutine libraries containing common computing algorithms. The Technical Services Division is responsible for more than 460 general purpose and statistical analysis programs and over 3,080 pages of user guides to those programs.

FY84 Milestones: AFHRL acquired the Author System for Education and Training (ASET) to provide computer-assisted instruction to personnel using the Sperry 1100/81 computer system. New ASET courseware is being developed to teach the use of in-house software systems. New software systems developed during FY84 include (a) the basic descriptive statistics package, (b) data preparation software for UTS-20 terminals, and (c) a general purpose data transformation program for generating statistical analysis variables and test scores.

Utilization: General purpose software supports virtually all Sperry 1100/81 data processing activities related to AFHRL R&D programs, as well as the computational support to other agencies such as the Air Force Manpower and Personnel Center and the USAF Occupational Measurement Center. One such program, PRISM, was designed

Title: SUPPORT OF COMPREHENSIVE OCCUPATIONAL DATA ANALYSIS PROGRAMS

AFHRL Contact: Janice Buchhorn
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The Comprehensive Occupational Data Analysis Programs (CODAP) system was developed to provide an efficient and effective method of identifying and classifying jobs in a rapidly changing Air Force environment. The Technical Services Division of AFHRL develops, maintains, documents and provides consultation in the use of the CODAP system by dataprocessing personnel at the Laboratory and at the USAF Occupational Measurement Center. The basic input to the system is information provided by a large number of supervisors and job incumbents in each occupational area being studied. Because the data are collected at the worker task level, CODAP provides a base of information that is flexible enough to address unanticipated management questions whenever they arise. Primary objectives in providing programming support are to improve the operational efficiency of the programs and to develop interactive terminal routines that relieve the user of routine activities associated with setting up computer runs.

FY84 Milestones: A nonhierarchical clustering program was developed for use in support of officer survey technology enhancements. Approximately half of the 60 programs included in the new CODAP system being written under contract to replace and enhance the current version were accepted after rigorous testing by this division. The USAF Occupational Measurement Center used CODAP software to perform analysis on 123 occupational survey studies during the year. In addition, about 20 research and development studies were processed in such areas as strength and endurance, task learning difficulty, and job/mission requirements.

Utilization: All branches of the Department of Defense, as well as the British, Canadian, and Australian military forces, have incorporated CODAP into their operational programs. CODAP is also used by the USAF Occupational Measurement Center in developing and validating the content of Air Force training programs. The AFHRL research staff uses CODAP to address questions about the requirements of jobs that will be integrated with the initial personnel selection process and eventually with the person-job-match model. Educational institutions are using CODAP to modify the curricula of their vocational education programs.

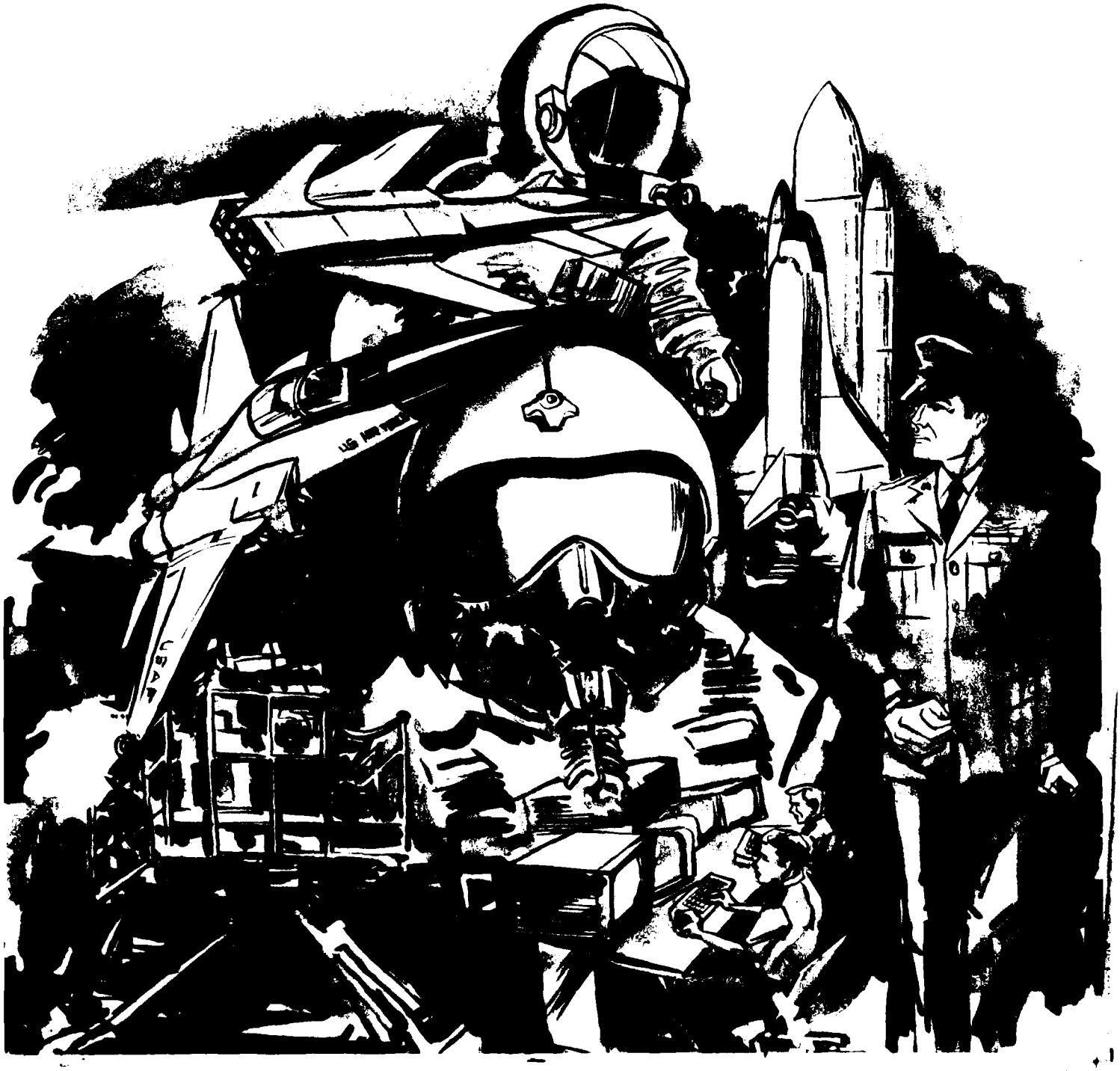
Benefits: The use of CODAP by the USAF Occupational Measurement Center has resulted in the elimination of irrelevant course content from technical training programs and identification of important material to be introduced into training. State governments and the private sector are using CODAP procedures in conjunction with occupational survey techniques to improve the selection and assignment of personnel and to meet the training needs resulting from changes in the workplace. Through the scientific structuring and analysis of jobs, more equitable pay systems are implemented, bias in hiring and promotion is avoided, and job satisfaction is increased through the proper matching of individuals and jobs.

Title: FOLLOWUP ON ROTC GRADUATES WITH SCORES OF 20 AND BELOW ON THE OFFICER QUALITY COMPOSITE

AFHRL Contact: Charles A. Greenway
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3921
AUTOVON 240-3921

Description: In 1971, the Air Force Reserve Officers Training Corps (AFROTC) enrolled some applicants for the advanced program without regard to the individual's score on the Officer Quality Composite (OQC) Test. Prior to this approval, cadets were required to score 25 or higher on the OQC for admission to the advanced program. After approval, applicants were selected using the Multiple Factor Selection System (MFSS) in which all available information about the applicant is considered along with the OQC score, which, though still a factor, is no longer a single eliminating element. Statistical comparisons of 320 AFROTC MFSS graduates and a comparative sample of 960 non-MFSS graduates commissioned in FY74 have been made for each fiscal year from 1976 through 1981 to assess the long-term similarities/differences in under-

TECHNICAL SUPPORT



TEAM TRAINING SYSTEMS

unanticipated negative impacts on system effectiveness, efficiency, operator numbers, skill/training requirements, and operational procedures.

Anticipated Benefits: General benefits include increased knowledge of the interactions between human operators, automated systems, and system performance. Specific benefits include impact assessment of automated systems prior to the commitment of substantial amounts of funds and manpower resources to develop the automation. These predictive models will attempt to ascertain whether proposed automation will actually improve combat effectiveness or hinder it.

Expected Completion/Delivery: Early FY88

LOGISTICS AND HUMAN FACTORS DIVISION R&D PRODUCTS

MAINTENANCE AND LOGISTICS IN COMPUTER-AIDED DESIGN: The opportunity for significant supportability improvement by using computer-aided design for logistics analysis was visibly demonstrated on redesign of the Ground Launched Cruise Missile Unique Turbine System.

UNIFIED DATABASE FOR ACQUISITION LOGISTICS: Software was evaluated through on-line use by a major contractor on B-1B defensive avionics and by small contractors through dial-up access to the Aeronautical Systems Division Computer Center.

MISSION RELIABILITY MODEL: This model permits reliability analysis and design improvement of new self-reprogramming avionics systems with graceful degradation. Its use in the design of the Integrated Communications Navigation Identification Avionics System is expected to result in a 30% reliability improvement.

TACTICAL COMMAND AND CONTROL COMBAT PLANNING AND ATTACK CAPABILITY: This comprehensive analysis of command and control personnel, training, and utilization issues is now being implemented by the Tactical Air Forces.

INFORMATION FLOW ANALYSIS OF THE USAFE OPERATIONS SUPPORT CENTER: This effort, done to improve training and wartime capability, has been delivered to Headquarters, U.S. Air Forces in Europe.

IMPROVED TRAINING FOR TACTICAL COMMAND AND CONTROL: The computer-based training system for EIFEL-1, developed to demonstrate AFHRL concepts, is being used successfully at U.S. Air Forces in Europe wings, the Allied Tactical Operations Center, and the Air Support Operations Center.

conditions. Additionally, a plan will be developed for the transition of the TAOTTS software to the hardware suite of the TBMS system for studies in the laboratory environment.

Anticipated Benefits: TAOTTS will significantly enhance the ability of the Tactical Air Command (TAC) to perform their mission. TACC personnel will no longer be limited in their continuation training due to the few number of training exercises held each year. Since the system is transportable, TACC personnel will be able to conduct this training at the home unit or on exercises. This transportability also means that TAOTTS has potential operational use in the field. TAOTTS will also significantly reduce the time required to generate ATOs. The result is a faster ATO generation time with automated quality control and on-line recording without interfering with the complex nature of the decision making to enhance future training for TACC planners, and with TAOTTS software modified for the TBMS, AFHRL will be able to collect data in-house, at the user facility, or at exercises.

Expected Completion/Delivery: A prototype preliminary analysis of TAOTTS is expected to be demonstrated at a Blue Flag exercise in June 1985. Final delivery is expected in the third quarter of 1986.

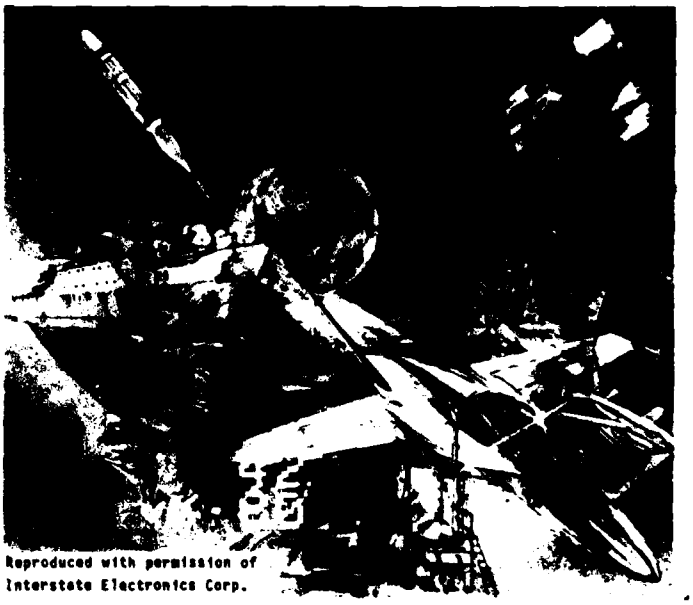
Title: MODELING THE IMPACTS OF AUTOMATION ON NON-AUTOMATED TACTICAL COMMAND AND CONTROL SYSTEMS

AFHRL Contact: Rosemarie J. Preidis
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: This program is intended to result in a series of computer-based modeling techniques to aid system planners and designers in predicting the impact of new automated systems on operator performance and the potential effects of such performance on overall system performance. The emphasis is on identifying and then quantifying the interactions between the automation and the human operator's decision when accomplishing the job. Specifically, the techniques will first attempt to map out the strategies used by operators under realistic wartime scenarios using the current (manual) procedures, and then to predict (measure) how those processes may change if a new (proposed) automation capability is inserted into the process.

Existing tools cannot predict the effects of new automated command and control (C^2) equipment on the performance of the human operators of non-automated systems, or on the overall effectiveness of the system itself. Presently, effects on operator performance parameters, such as timeliness, accuracy, and workload are not realized until the automation is incorporated into the operational system.

FY84 Milestones: A preliminary investigation on ways to define and describe the C^2 system process in a Control and Reporting Center was conducted July-September 1984. Results of this preliminary study are now being integrated into a more broadly focused feasibility asessment.



Command and Control Enhanced
Through Automation

Utilization: These new predictive modeling techniques can be used by system planners, designers, and evaluators to assess the potential consequences of proposed automation prior to operational implementation. Such information can reduce the number of

device and combat planning tool for target analysis by Tactical Air Control Center Combat Plans personnel.

FY84 Milestones: The first step in this work unit was the performance of a feasibility study to assess the technical state of the art for generating high-detail, high-realism, perspective scenes that would be required for tactical C^2 applications.

Utilization: The present effort will extend and refine spatial simulation technology for specialized application to tactical C^2 systems. By presenting a three-dimensional, changeable-perspective "picture" of a highly specific target area, greater amounts of precise target information will be available in an efficient and meaningful format for tactical C^2 combat planners.

Anticipated Benefits: The precise targeting information extracted from the CIG display may significantly improve the manner in which support and strike packages are planned, coordinated, controlled, and executed. Training capabilities will enhance combat readiness of tactical C^2 personnel.

Expected Completion/Delivery: A laboratory prototype system is expected to be installed at the AFHRL Logistics and Human Factors Division by December 1985. A series of behavioral experiments will be used to develop and refine specifications for a field test system, which is expected to be delivered during 1987. Field investigations will then be conducted to determine the actual impact of the new capability on operator performance, training requirements, and the target planning process.

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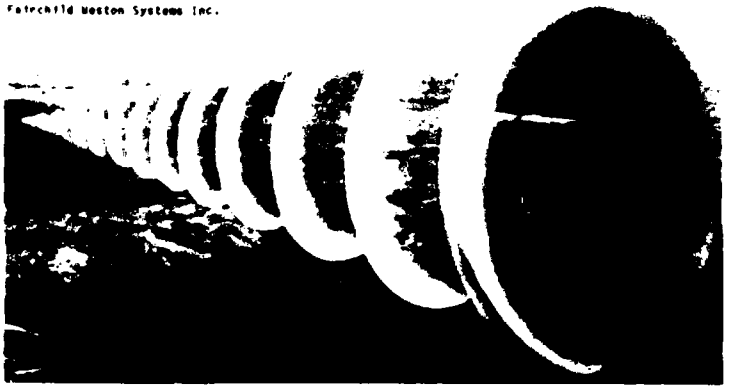

Developing High Technology for Command and Control

Title: TACTICAL AIR OPERATIONS TEAM TRAINING SYSTEM

AFHRL Contacts: Capt David A. Barnthouse
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: The objective of the Tactical Air Operations Team Training System (TAOTTS) is to gather data on tactical decision making and to provide training on generating Air Tasking Orders (ATOs) for combat planners on a Tactical Air Control Center (TACC). TAOTTS is a prototype computer-based text and graphics system that can serve as a planning aid for personnel who write ATOs. This system enlarges on the Tactical Battle Management Software (TBMS) system. Where TBMS was limited to generating ATOs for offensive counterair missions only, TAOTTS expands this capability to all types of missions generated by the TACC. Also, where TBMS was an in-house project located in a laboratory, TAOTTS is designed to be transportable for data collection at exercises and field sites.

FY84 Milestones: Contract work on TAOTTS was initiated in the fourth quarter of 1984. Work completed during this period included requirements analysis and data collection, hardware/software specifications, and experimental data from TBMS experiments run in 1983, as well as extensive coordination with TAC, the 9th Air Force, and the Rome Air Development Center for this effort.

Utilization: TAOTTS will allow combat planners in a TACC to better perform their mission; i.e., generate ATOs. To aid them in this process, TAOTTS will contain embedded training modules allowing for continuation training at the user's facility. The system will be transportable and user friendly. Combat planners will be able to update and modify databases to depict the currently used scenario. The system also will include a data recording module so planners can extract information to help them better perform their mission. This same module will allow AFHRL personnel to continue gathering data on the tactical decision-making processes of combat planners under more realistic exercise

significantly increased through the improved training and team exercise provided by the LOGEX program. The R&D products of LOGEX are also expected to be useful for other C^2 organizations in the development of new team training and exercise programs.

Expected Completion/Delivery: Mar 88

Title: IMPROVED TRAINING FOR TACTICAL COMMAND AND CONTROL BATTLESTAFFS

AFHRL Contact: Judith C. Krebs
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: Technology is needed to develop, test, demonstrate, and evaluate the training and evaluation of personnel who operate tactical command and control (C^2) systems. Attention is being directed to the importance of the individuals and teams who operate these systems and the interaction between human performance, hardware, and operational procedures. Emphasis is also being placed on the actual definition of wartime skills and procedures. This project is developing new methods for analyzing peacetime/wartime job performance and training requirements, determining training and evaluation requirements, and designing training programs.

FY84 Milestones: A methodology for extracting wartime requirements from a peacetime environment was developed and field tested in two Blue Flag Exercises and at the Allied Tactical Operations Center, Sembach, Germany. An automated task database and exercise planning aid was developed for use in Blue Flag Exercises. A training system was developed for USAFE. This system provides computer-based instruction for EIFEL-1 users located at the wings, the Allied Tactical Operations Center, and the Air Support Operations Center.

Utilization: The development of analysis technology for accurately identifying actual wartime training requirements will make it easier to select and train personnel for critical positions in Tactical Air Control Centers (TACCs). The analysis techniques are extending and refining a number of existing methods (e.g., task/systems analysis). These methods are especially important for the development of accurate training programs that cover specific wartime requirements.

Anticipated Benefits: With improved assessment and training, augmented tactical C^2 teams will reach peak effectiveness faster in crisis and war situations.

Expected Completion/Delivery: Four additional training programs will be developed and delivered in 1985 and 1986.

Title: ADVANCED SPATIAL SIMULATION TECHNIQUES TO SUPPORT 1990'S TACTICAL COMMAND AND CONTROL PLANNING

AFHRL Contact: Michael Venturino
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: The current process of planning tactical air strikes against enemy targets is a complex and interactive process. The combat planner must utilize large amounts of intelligence information to make judgements regarding weapons and fuel requirements, attack/support aircraft types and numbers, refueling requirements, etc. Consequently, large volumes of intelligence information are presented to battle commanders/planners at very rapid rates. Such volumes and rates of information flow may exceed the capabilities of the human information processing system. Additionally, the high speed of modern aircraft, weapons, and electronic warfare techniques (jamming etc.) reduce the time available for tactical command and control (C^2) functions and decisions. Advances in spatial simulation technology, such as Computer Image Generation (CIG) techniques, present a possible solution to the difficulties inherent in the tactical C^2 environment. One purpose of this project is to investigate the human performance and system operation implications of adding the capabilities inherent in CIG target imagery to the Air Tasking Order generation process. A second purpose is to investigate the actual value of a spatial simulation training

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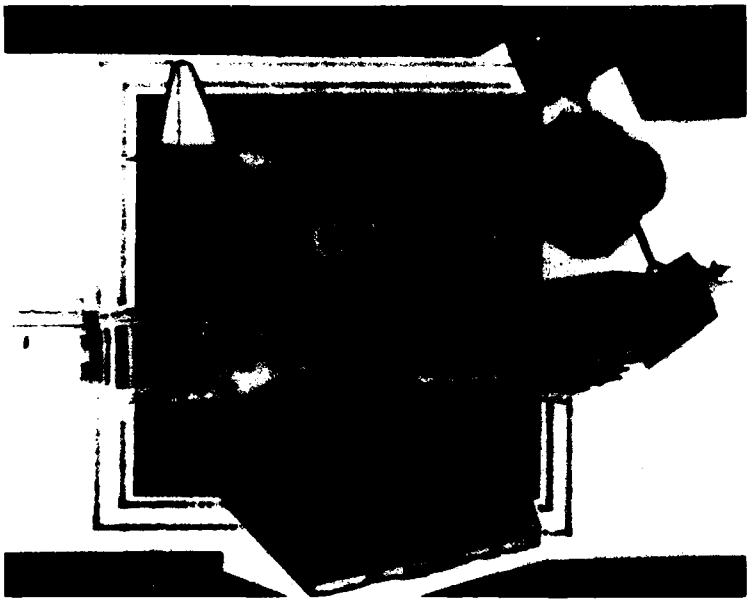


Command, Control, Communications, and Intelligence Operations Conceptualized

and preparation for wartime operations. Additionally, lengthy discussions with senior USAFE staff members resulted in modifications to existing plans for automation, training, and documented requirements. Exercise observations, coupled with previously collected data, confirmed the need for enhanced wartime readiness training for USAFE logistics personnel. This has resulted in another USAFE Logistics Need (LN) for development of a microcomputer-based team training exercise capability. Finally, many of the project's conclusions and recommendations have influenced USAFE planning for OSC automation and organizational management initiatives.

Anticipated Benefits: Changes resulting from this project will improve USAFE wartime capability.

Title: LOGISTICS TRAINING AND EXERCISE PROGRAM

AFHRL Contact: Lawrence S. Finegold
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: A microcomputer-based, combat-focused training and exercise system is being developed for the U.S. Air Forces in Europe (USAFE) logistics command and control (C^2) personnel. In addition to their peacetime mission, these personnel are responsible for management of U.S. logistics assets during crisis, transition, and wartime activities in the European theater. Training for these personnel is a significant requirement for USAFE wartime force readiness. The Logistics Training and Exercise program (LOGEX) will result in a computer-based individual and team-training exercise system to address this training need. It will also address several R&D issues relevant to team training within the broader C^2 environment.

There are two phases to the Logistics Training and Exercise (LOGEX) program. The first involves the development of flexible, computer-based training packages to address USAFE logistics C^2 requirements. The second phase involves the development of a computer-assisted exercise capability to allow these personnel to practice their expected crisis, transition, and wartime functions via a locally managed and controlled exercise system.

FY84 Milestones: Progress during FY84 included the development of management and technical plans for this effort, and delivery of a first draft of an initial training package to HQ USAFE.

Utilization: This effort will result in a prototype training and exercise system for the USAFE logistics C^2 community, including field-level and CONUS-based logistics supporting personnel. The LOGEX system will allow these personnel to receive systematic training to learn how to solve realistic wartime problems and to receive performance feedback during training and exercises.

Anticipated Benefits: The operational readiness of the USAFE logistics community will be

serves as a guide for systematically achieving the desired capability.

FY84 Milestones: The COMPAC plan was completed and transitioned to Tactical Air Command (TAC) in FY84. TAC distributed the plan to all Tactical Air Forces (TAF) Major Commands for review and comment. The feedback was positive, and implementation of selected portions of the plan is currently underway.

Utilization: This plan provides options for TAF to establish a high-fidelity tactical C^2 training and evaluation capability. This capability will serve three primary functions: (a) to train and evaluate key personnel assigned and/or scheduled to augment tactical C^2 systems in their combat duties, (b) to provide a capability to evaluate the operational impact of new C^2 system components on overall system operations, and (c) to assess the efficiency and effectiveness of existing and new procedures and strategies. This plan has been briefed to high-level TAC and Air Force Headquarters personnel and received highly favorable reaction. TAC has circulated the plan worldwide for comments. Responsibility for this program has passed to TAC, with additional AFHRL work to be requested by TAC as required.

Benefits: The COMPAC plan provides specific suggested steps that, if followed, will result in increased combat effectiveness of TAF. System spin-up time to respond to crisis and/or launch initial combat sorties will be significantly shorter and more effective, since tactical C^2 personnel will be highly familiar with their wartime jobs and can easily transition from peacetime duties to wartime requirements. More effective combat sortie planning will result from experience in realistic combat training provided to the combined tactical C^2 system members. Finally, commanders will have had the opportunity to innovate and practice new methods of countering expected and unexpected threats. Consequently, they will know the limitations of their own systems and those of the enemy. The data collected during the development of this plan have also identified a number of R&D shortfalls that will be addressed in future programs.

Title: INFORMATION FLOW ANALYSIS OF THE UNITED STATES AIR FORCES IN EUROPE OPERATIONS SUPPORT CENTER

AFHRL Contact: Bertram W. Cream
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

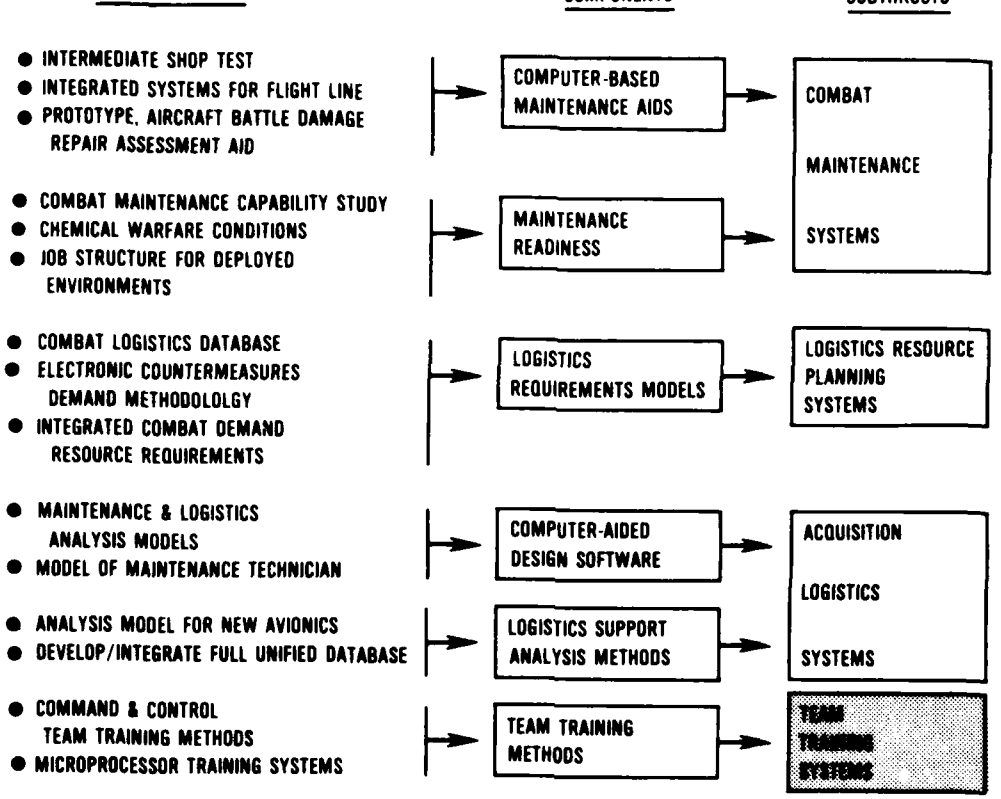
Description: An analysis of the U.S. Air Forces in Europe (USAFE) War Support Command and Control (C^2) System was requested by USAFE. AFHRL developed a systems analysis methodology to identify ways in which USAFE could improve current operations and provided specific short-term and long-range suggestions for USAFE implementation. This systems analysis methodology permits a systems-level understanding of Operations Support Center (OSC) functional requirements through the analysis of wartime OSC C^2 functions, essential information flow, and command decision processes. The suggestions to improve current system processes and capabilities cover improved training, automation, and management, and illustrate the value of the approach.

The analysis provides a systematic method for development of a "roadmap" for improvements in both current and future OSC operations. The analysis was accomplished over a 2-year period by a team from the AFHRL Logistics and Human Factors Division, which included logistics, training, modeling, C^2, and automation specialists. Data were collected through numerous trips to USAFE for extensive document review and interviews with personnel. The analysis team also observed two small, practice command-post exercises, as well as a large-scale exercise involving the North Atlantic Treaty Organization.

FY84 Milestones: The final draft report was delivered to USAFE in April 1984.

Utilization: A number of intermediate products were provided to USAFE personnel during the course of the analysis. Many of these were immediately implemented into daily operations

TEAM TRAINING SYSTEMS



TECHNICAL ACHIEVEMENTS

Title: TACTICAL COMMAND AND CONTROL COMBAT PLANNING AND ATTACK CAPABILITY

AFHRL Contact: Judith C. Krebs
AFHRL/LRG
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-5910
AUTOVON 785-5910

Description: A feasibility plan was developed for an Air Force-wide tactical command and control (C^2) training and evaluation capability. To date, limited capabilities exist to train and evaluate commanders and battlestaffs in their specific wartime duties. One overriding contributing factor is that combat-configured C^2 systems do not operate in peacetime. Many of the personnel who staff the combat systems may have different peacetime duties, creating a disconnect between peacetime duties and wartime job requirements. For example, there are significant differences between modes and types of operations, numbers of aircraft (including allies), constraints, stress levels, consequences of actions, availability of communications and other types of critical information, and criteria of success.

This feasibility plan, known as the Combat Planning and Attack Capability (COMPAC), was based on the assumption that an identified and trained cadre of C^2 professionals can significantly enhance wartime readiness. Data collection consisted of in-depth interviews, review of existing documentation, and on-site observations at command post exercises (CPXs) and field training exercises (FTXs). The plan documents the current capability for training and management of key tactical C^2 battlestaffs and battle managers, identifies future requirements and suggests options for achieving the desired capability. Areas covered include training, professional military education, personnel policies, automation, and management issues. Based on these data, the final plan

Title: LOGISTICS ANALYSES FOR THE INTEGRATED COMMUNICATION NAVIGATION IDENTIFICATION AVIONICS SYSTEM

AFHRL Contact: James C. McManus
AFHRL/LRL
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-8418
AUTOVON 785-8418

Description: Tools and techniques need to be identified for incorporating logistics engineering parameters into system design during the conceptual phase. These analysis techniques will be demonstrated by applying them to the front-end analysis portion of the Integrated Communication Navigation Identification Avionics (ICNIA) system conceptual phase. Among the unique problems being addressed is the development of reliability-analysis techniques for graceful degradation. The work includes four major tasks applied to two conceptual ICNIA system architectures developed by the Air Force Avionics Laboratory. Incorporated into these tasks is a front-end analysis to determine the problems associated with logistics engineering during the conceptual development of new avionics and to identify the techniques needed to accomplish logistics analysis. The major tasks involve developing front-end analysis techniques in the areas of logistics support, reliability, survivability, and fault tolerance and applying them to the architectures of the two ICNIA systems. In FY85, a users handbook and supporting guidance documentation for programming will be identified and developed. The documentation will provide sufficient detail and clear guidance for use of these analyses. User-friendly computer programs will also be prepared for the Mission Reliability Model (MIREM) developed under this effort in the first quarter FY85.

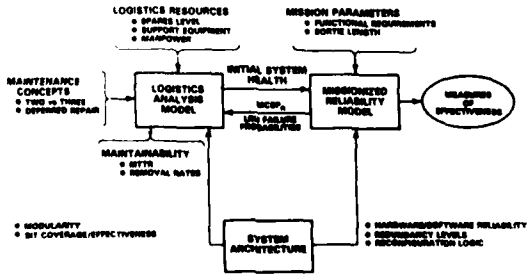
FY84 Milestones: The MIREM underwent several improvements. The computer model was translated from PL/1 language into FORTRAN 77. MIREM was made more user friendly with the creation of DATAIN, a separate, interactive, data-entry program that simplifies the creation of MIREM's architecture and scenario files. The contractor delivered a draft version of the MIREM users guide.

Utilization: The results of this effort will provide guidance concerning analysis techniques plus indicators of logistics support, and survivability for the two ICNIA system architectures.

Anticipated Benefits: The technology and the analysis techniques developed will be used by Government and industry engineers to evaluate the impact that various conceptual design elements will have on equipment reliability, maintainability, and survivability. The MIREM model will be used by system designers to determine the overall reliability of each design and to perform sensitivity analysis to improve those designs. Its use is expected to increase the reliability of ICNIA by at least 30%. As ICNIA will be retrofitted to a major part of the existing Tactical Air Command fleet, as well as incorporated in new aircraft, this will be an enormous improvement in life cycle cost and mission capability.

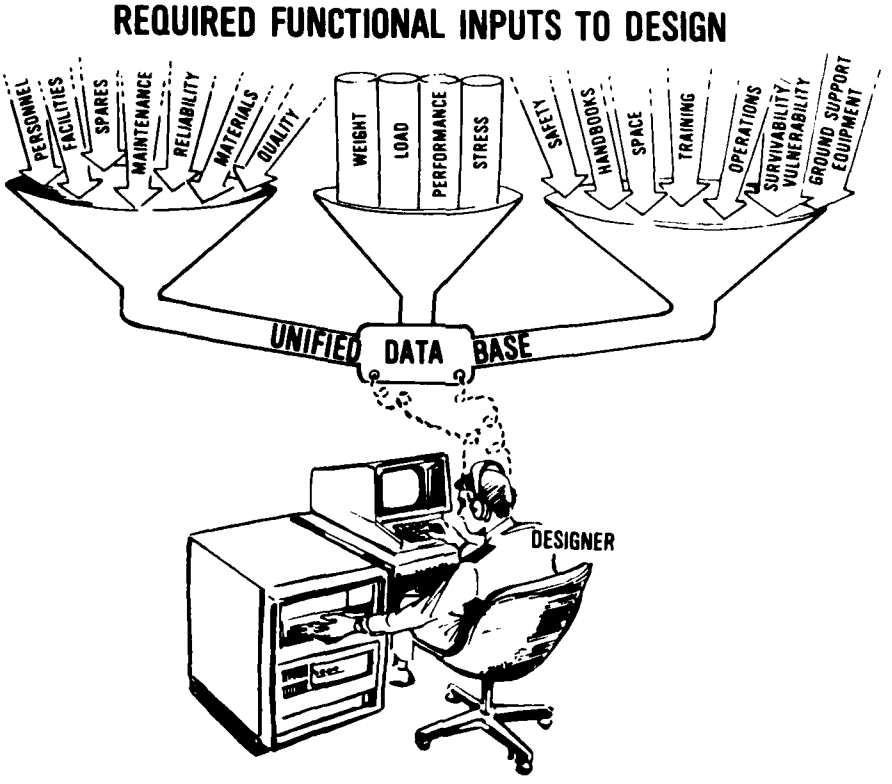
Expected Completion/Delivery: Feb 85

METHODOLOGY OVERVIEW



system will be tested and demonstrated on a representative weapon system acquisition program. After testing, it will be transitioned to the Air Force Acquisition Logistics Center where it can be provided as a government-furnished program to contractors for use in weapon systems development.

Anticipated Benefits: Automation and easy access to the logistics planning database for new weapon systems will increase consideration of logistics factors in weapon systems design and, thus, will aid in reducing long-range system support costs. These include decreased logistics life-cycle costs for new weapon systems, as well as savings in acquisition due to the use of a standard data management system.



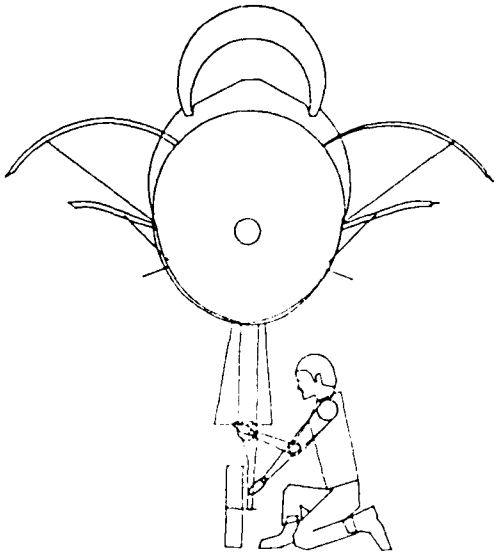
as overall arrangement for aircraft quick combat turnaround), and subsystem/component level evaluations in detail design (such as accessibility, and remove and replace operations).

Anticipated Benefits: The computer graphics CREW CHIEF model will provide the means to evaluate proposed designs long before costly mockups and prototypes are built. This has at least two major benefits. First is the increased probability that design changes to improve supportability will be made, because of the fluid nature of the design during the early phases. Second is the dollars saved by making changes at the CAD stage versus at the mockup and prototype stages when designs are more firm, and, consequently, changes are much more expensive to make.

Expected Completion/Delivery: FY88, with early versions of the CREW CHIEF model tested during FY86 and FY87.

CREW CHIEF

COMPUTER GRAPHICS MODEL OF THE MAINTENANCE TECHNICIAN



Title: UNIFIED DATABASE TECHNOLOGY

AFHRL Contact: Janet L. Peasant
AFHRL/LRA
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-3871
AUTOVON 785-3871

Description: Unified Database (UDB) software is being developed for a central automated source of logistics data drawn from basic Air Force systems to support the weapon systems development process. Logistics data are those data that would assist logisticians and designers in obtaining answers to questions about logistics requirements as a function of alternative design/support concepts. Logistics data include reliability, maintainability, vulnerability, ground-support equipment, built-in test equipment, task analysis, skill level, crew size, training requirements, technical data, and spares. The UDB automates Logistics Support Analysis Records (Military Standard 1388) and draws data from the Air Force Maintenance Data Collection System. The UDB is a flexible system using a powerful database manager with a variety of data output modes available to the user.

FY84 Milestones: The final report on the prototype UDB was published in March 1984. A contractor compared the data elements defined by Military Standard 1388-2A to the data elements included in the prototype UDB. Preliminary design of on-line data entry screen formats was accomplished. Prototype software was transitioned to the Aeronautical Systems Division computer at Wright-Patterson AFB, OH, from the contractor, where it is being applied on the B1-B aircraft program. A test data set of the contractor's Logistics Support Analysis Records (LSAR) was also delivered and loaded into the database.

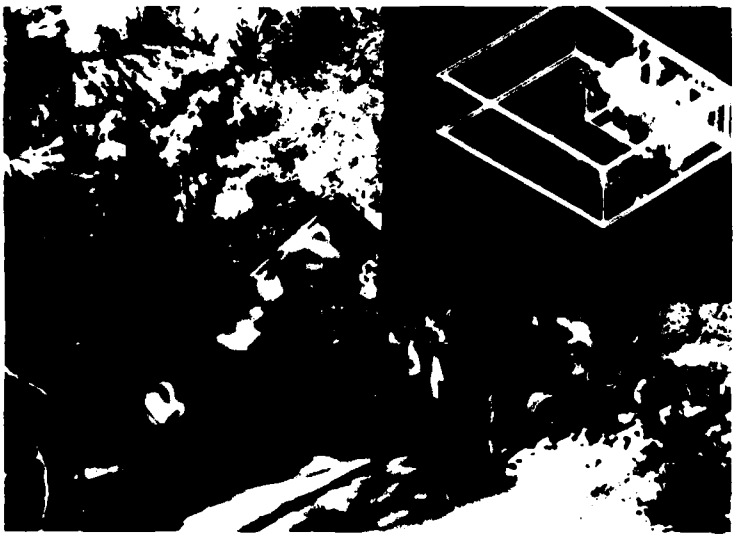
Utilization: Enhanced availability of logistics information will permit increased consideration of logistics factors throughout the weapon systems development process. Prototype software has been developed and tested and is being used in support of a major acquisition program. The advanced development program in FY85 will address automation of the new Military Standard 1388-2A data and interface with CAD through the Integrated Design Support System. The full

FY84 Milestones: The GLCM demonstration was highly successful. The GLCM turbine system data were digitized for manipulation in CAD, a number of accessibility analyses were accomplished, a thermal map was developed, an alternative turbine engine was evaluated in a very short time, and 19 of 26 supportability design recommendations were accepted. The F-16 testability demonstration was started. The IDA effort to identify opportunities for new CAD techniques was initiated. A JLC subpanel on RAMCAD was chartered.

Utilization: The MLCAD development efforts will be successfully utilized by industry when industry routinely incorporates logistics supportability considerations in early design.

Anticipated Benefits: Quantum improvements in designed-in supportability will improve weapons, reduce turnaround times, improve mission reliability, and reduce logistics pipeline requirements.

Expected Completion/Delivery: The first short-term demonstration will be completed in 1985. Technical specifications will be completed by 1986, while development and transfer of key technologies to industry will extend until 1989.



3-D Computer Aided Design of Power Generator for Improved Supportability

Title: CREW CHIEF - A COMPUTER GRAPHICS MODEL OF THE MAINTENANCE TECHNICIAN

AFHRL Contact: Alan Winn
AFHRL/LRA
Wright-Patterson AFB, OH
45433-6503
Commercial (513) 255-3871
AUTOVON 785-3871

Description: CREW CHIEF, a three-dimensional, computer graphics model of the maintenance technician is being developed for use in computer-aided design (CAD) evaluations of proposed equipment. The CREW CHIEF model will be used to evaluate maintenance and support characteristics of the equipment. The model will represent both male and female maintenance technicians in terms of body size and strength capabilities. The model will have three clothing options: normal work fatigues, cold weather clothing, and chemical defense gear. CREW CHIEF will include use of common handtools and will assess visual limitations occurring as a result of design features. Final products will include math models and computer software representing the maintenance technician; databases depicting male and female body sizes, strength, and visual capabilities; validation data of the utility of the model; and user manuals for operation of the model. CREW CHIEF is being developed to work with CAD systems currently in use in the aerospace industry. This R&D program is a joint effort with the Air Force Aerospace Medical Research Laboratory (AMRL).

FY84 Milestones: A CAD laboratory was set up in AFHRL, that operates by microwave link to the CAD computer at the Aerospace Medical Research Laboratory (AMRL). The Division developed a simple two-dimensional model to test the CREW CHIEF concept. Scientists conducted and completed the first experiment in support of CREW CHIEF, "An Experimental Investigation of Human Torque Strength," at the AMRL Ergonomics Laboratory.

Utilization: The CREW CHIEF model of the maintenance technician will provide the capability to assess designed-in maintenance and support features of proposed equipment designs. The model will be sufficiently flexible to permit system-level evaluations in early design (such

as a high-level utility programming language specifically for the development of interactive programs with complete control of all Sperry 1100/81 facilities and file structures.

Benefits: AFHRL derived significant benefits from the development of general purpose programs. These benefits included (a) reduction in the number of unique occurrences of a computing algorithm thus decreasing the possibility for error, (b) increasing individual programmer productivity by reducing the number of special purpose programs written and audited, (c) standardization of products to reduce analysis time by researchers, and (d) a concentration of program maintenance and enhancement activities into a group specialized in the production of efficient computer software.

Title: FILE ITEM DATA ORGANIZER

AFHRL Contact: Roger L. Camp
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3937
AUTOVON 240-3937

Description: The File Item Data Organizer (FIDO) consists of a database, containing selected data elements and code definitions from Air Force Regulation 300-4, Vol III, Air Force Data Dictionary, and earlier code systems, and an automated update and retrieval system. FIDO was developed and is maintained by the Technical Services Division to meet the needs of personnel research scientists in conducting longitudinal research projects and in determining the feasibility of proposed major R&D efforts involving personnel databases. FIDO also provides a file edit capability, showing the frequency of occurrence and the definition of every code value for each data element which appears in a data file. These frequency distributions are available on microfiche. FIDO is on-line on the AFHRL Sperry 1100/81 computer. The database currently contains 752 Air Force and DoD defined data elements, e.g., security classification, grade, AFSC, and academic specialty. As these code meanings are dynamic over time, reflecting changing personnel policies and supporting systems, they are tracked in FIDO by effective date, enabling the researcher to obtain English language meanings for each code value in effect for any particular historical file.

FY84 Milestones: AFHRL completed a major FIDO conversion to standard ASCII format, and revised the database to be compatible with the newly installed system at the Air Force Data System Design Office (AFDSDO), which is the prime source of AFR 300-4 data codes and definitions. Update procedures were streamlined, reducing manual input and auditing by over one quarter manyear. A temporary duty assignment to AFDSDO at Gunter Air Force Station provided for the exchange of information and products to the mutual benefit of AFHRL and AFDSDO.

Utilization: FIDO directly supports virtually all facets of personnel and manpower R&D conducted by AFHRL. It is used by task scientists to determine project feasibility, to define special application files, to identify the best source files for personnel information, to edit databases and to interpret results. It is used by other agencies, such as the Air Force Manpower and Personnel Center and Air Training Command, to edit their data files.

Benefits: FIDO's on-line retrieval capability for historical code values eliminates three manyears of manual research annually, yet costs approximately one man-year to maintain. In addition, FIDO has proved itself a valuable tool for improving database accuracy, both at AFHRL and for agencies which provide the source data, including AFMPC, ATC, and AFDSDO. For scientists, more accurate databases yield more reliable research results, and for managers, more effective management of the force.

Title: OFFICER EFFECTIVENESS REPORT R&D DATABASE/SUMMARIES

AFHRL Contact: James L. Friemann
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Charles A. Greenway
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3921
AUTOVON 240-3921

Description: The Technical Services Division performs data processing and related services to automate Officer Effectiveness Reports (OERs)

and to maintain the data in a historical OER master file for the Assistant for Personnel Plans, Programs, and Analysis, Air Force Manpower and Personnel Center (AFMPC). Quarterly and annual summary reports are provided to AFMPC, along with statistical analyses in support of special OER studies. In return for these services, the OER data are available for use in AFHRL research studies.

FY84 Milestones: In FY84, OER summaries were completed for the second, third, and fourth quarters of calendar year 83, along with the cumulative year-end report for CY83. Quarterly reports for the first two CY84 quarters were also provided, and five special OER analysis studies were completed for the Air Force Manpower and Personnel Center.

Utilization: The automated OER data are used by the AFMPC to conduct analyses relating to assessment of the OER system and possible changes in evaluation policy. The quarterly OER summaries are sent to Major Commands and large Separate Operating Agency staffs to assist them in managing their respective OER programs. The quarterly summaries and special OER studies are used by the AFMPC to respond to formal OER information requirements (e.g., Air Staff or Congressional inquiries, Freedom of Information Act requests, and Air Force Annual Equal Opportunity Assessment Report) and to provide background information for a variety of forums such as CORONAs, Personnel Management Team visits, functional manager workshop, and conferences.

Benefits: The OER information provided allows senior Air Force leadership to better judge the effectiveness and utility of the officer evaluation system by providing timely identification and description of rating and indorsement trends. The data are critical in ensuring that reports conform to Air Force evaluation policy and impacts on all personnel management decisions (e.g., promotions, assignments, augmentation, school selection, separation, and retention).

Title: OFFICER HISTORICAL DATABASE/COHORT FILE

AFHRL Contact: Roger L. Camp
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3937
AUTOVON 240-3937

Description: AFHRL maintains a large number of historical officer personnel files used in its personnel research studies. These include master files dating back to 1960. For each project involving research across time, the appropriate files must be identified, the relevant data extracted, and the meanings of the historical codes determined before data can be compared. The objective of the Officer Data-Base/Cohort File is to provide information in the areas of accession, retention, and potential impact of policy changes on the structure of the officer force, and to provide this information to managers, planners, and researchers in a timely and economical manner. This database research system is being developed in a systematic fashion to provide limited use files on the most current data first, so as to provide usable files in a relatively short time. The database will include an Augmented Identity File (AIF) used to purify record identities in the historical database, an extract or "Snapshot" file containing key personnel data from each of the master files, consecutive groups of Snapshot files merged into Profile files describing the officer force over specific periods of time, and a Comprehensive Officer Gain and Loss file to provide a before-and-after record on each case in the database, showing the member's personnel characteristics at time of entry into the Air Force and at time of separation or retirement. These data will be combined with related data obtained from other sources.

FY84 Milestones: Work Unit 63230111, Officer Database/Cohort File, was approved 27 July 84. Sixty-eight master files dating back to 1960 have been matched against the Identity File, and a Snapshot file extracted from each. A recode

program has been written, and the Snapshot files are being recoded to a common set of code values to enable the projection of data across time for longitudinal studies.

Utilization: This database research system is being developed primarily for use by managers at the Air Staff level. The initial content of the extract files was determined based upon Request for Personnel Research 82-08, submitted by the USAF Manpower and Personnel Analysis Center. In addition, personnel research scientists, and managers and analysts at other levels will benefit from its capabilities.

Benefits: The system will provide readily accessible, quick turn-around historical data retrieval and analysis. This will reduce the time lost in analysis projects because of incorrect assumptions regarding the force and will replace the need to maintain a large number of small, fragmented databases. This database will eliminate much of the preliminary processing and analysis efforts needed to establish the initial databases for particular research studies and will provide more accurate data in less time. Emphasis can be shifted from data preparation to analysis of results, with better use of our analyst resource. The system will provide rapid information for Air Force managers who now must often make time-constrained decisions without analysis support.

Title: HISTORICAL DATABASE OF ENLISTED PERSONNEL BY COHORT YEAR GROUP

AFHRL Contact: Charles A. Greenway
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3921
AUTOVON 240-3921

Description: This database is extracted from the Airman Gain/Loss master file and has been developed covering accessions and associated loss/reenlistment/extension transactions for a 10-year "moving window" period on which reports are based. Summary and detailed statistical tables using this database are prepared annually. The statistical summary tables provide a quick reference to trends of losses/reenlistments/extensions of the beginning population for each fiscal year tracked over a 10-year period.

Cohort Database Facilitates Retention Analysis

Detailed reports provide trends data on the same 10-year time period. Losses, reenlistments, and extensions are tracked by specific categories during Basic Military Training (BMT) and subsequent to BMT over 10 years. The categories include sex, race, academic education level, Armed Forces Qualification Test (AFQT) group category, term of enlistment, age at accession, number of dependents, and marital status.

FY84 Milestones: A system of programs has been developed to process all subsequent studies on the cohort database and will provide a more accurate and easy to follow audit trail. The cohort report covering July 1972 thru September 1982 has been forwarded to HQ USAF Analysis Division, Directorate of Personnel Plans. Two studies for the July 1973 thru September 1983 and the July 1974 thru September 1984 time period are being processed in parallel, and will be completed on or about April 1985.

Utilization: These reports are used by personnel managers at Air Force Headquarters to track enlisted retention by cohort year groups, to relate enlisted losses/reenlistments to personnel program objectives, and to analyze the retention/reenlistment/losses of cohort year groups by various demographic attributes.

Benefits: The results of these annual cohort reports will fill a current void; specifically,

the ability to track retention by cohort year groups. Overall, it will add to the personnel analysis system by broadening present capabilities. Each one percent increase in retention, which can be attributed to improved analysis and projection of program impacts facilitated by these reports, translates to a cost avoidance of $8 million in training investment.

Title: *HUMAN RESOURCES RESEARCH DATABASE*

AFHRL Contact: Charles A. Greenway
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3921
AUTOVON 240-3921

Description: The Human Resources Laboratory database is composed of a series of databases containing information on personnel and training systems. These data are organized into readily accessible databases for support of R&D studies of the personnel system, to display selected information from a single database, and to consolidate information on a common subgroup from two or more databases. These data reflect personal characteristics on officer and enlisted personnel at time of entry to active duty, performance outcomes during flying or technical training, career status at periodic intervals, and information related to reenlistment or separation. Special files will be created to meet long-term study requirements, and longitudinal files will be constructed to facilitate studies in career development. Plans are being developed to build dynamic database systems for officers and airmen capable of providing responses to operational and research investigators. These database systems will eliminate the requirements for many small fragmented databases and greatly reduce the start-up time and cost of many personnel research efforts.

Major master personnel files are maintained historically on Air Force enlisted and officer personnel and include enlisted strength file from 1964, officer strength file from 1960, officer effectiveness report file from 1956, flying training file from 1964, and Air National Guard and Reserve files from 1970. These files are received from various Air Force agencies, such as Air Force Manpower and Personnel Center, Air Training Command, Air University, and Air Reserve Personnel Center. Special longitudinal files, such as the airman gain/loss and officer gain/loss are developed in-house from these databases and significantly reduce data processing requirements in many personnel and training R&D studies.

FY84 Milestones: All master personnel data files have been processed and updated through FY84. Statistical distributions were developed from 150 files.

Utilization: The database is used in the development and validation of personnel selection and classification instruments, development of assignment procedures, derivation and revalidation of promotion systems, and special-purpose analyses to determine the long-range impact of specific personnel and training policies. The availability of these data makes it possible to carry out studies on numerous aspects of the personnel and training systems that would otherwise be infeasible. Extracts of these data are used by AFHRL, Headquarters Air Force, the Air Force Manpower and Personnel Center, the Air Training Command, and the Rand Corporation.

Benefits: The AFHRL database provides data to solve personnel management problems related to selection, classification, retention, and force utilization. Databases provide data critical for the development of revised Air Force enlistment standards and will be the basis for market analysis of the applicant pool.

Title: *AIR FORCE PERSONNEL SURVEY PROGRAM*

AFHRL Contact: Charles R. Rogers
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The Technical Services Division provides optical scanning and computational support on the Sperry 1100/81 computer system for Air Force personnel surveys approved by the Research and Measurement Division of the Air Force Manpower and Personnel Center (AFMPC).

FY84 Milestones: The data reduction and analyses of 36 surveys during FY84 were accomplished by using general purpose computer programs

developed in the Technical Services Division. Pre-survey work included sample selection and the preparation of self-adhering address labels.

Utilization: Upon completion of each survey analysis, the raw data files are retained for use in Laboratory R&D programs. The survey products are used by Air Force managers at all levels.

Benefits: Processing Air Force personnel surveys at AFHRL enables the AFMPC to use state-of-the-art hardware and software to provide exceptionally rapid response to user requests. They also receive the same systems analysis, programming and training support that is provided to other users of the AFHRL computer facility. Statistical analyses of survey item responses assist managers to determine if there are significant differences in attitudes, opinions, and assignments and utilization between subgroups within the force.

Title: TECHNICAL TRAINING GRADUATION/ ELIMINATION RATES

AFHRL Contact: Laurel J. Betz
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3921
AUTOVON 240-3921

Description: Data on graduation/elimination rates from technical training courses, supplemented by aptitude and demographic data, are reported in the form of frequencies and percentages for nine categories of race/sex combinations, education, aptitude, and mental category. Summary reports are prepared quarterly and annually for Air Force enlisted personnel who terminated technical training in each quarter of the fiscal year.

FY84 Milestones: Summary reports for each quarter of FY84 and aggregated over all of FY84 were completed.

Utilization: These statistical reports are used to focus on the trend of total attrition from technical training courses with special emphasis on the high-cost electronics courses that require a minimum score of 80 for admission. The reports provide early identification of those resident technical training courses in which elimination rates are increasing rapidly and threaten the scheduled delivery of trained personnel in sufficient numbers to fill the trained personnel requirements. Information needed for briefings at higher echelons is also obtained from the reports. The reports are used by the Air Force Manpower and Personnel Center and by the Air Training Command.

Benefits: The summary reports provide personnel managers with data to track graduation/ elimination rates of enlisted personnel from basic resident technical training courses at 3-month intervals and aggregated over each fiscal year. The capability to track specific courses for potential out-of-tolerance elimination rates and to identify input subgroups which contribute most heavily to the problem provides resource managers with information needed to redefine mandatory and desirable admission standards and to modify guaranteed-program recruiting goals. Also, non-guaranteed program high-risk students can be redistributed to alternative technical training with improved likelihood of success.

Title: SUPPORT TO AFHRL DIVISIONS

AFHRL Contact: Doris E. Black
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The AFHRL Technical Services Division performs large-scale statistical services and data-processing support for Laboratory R&D programs. These services are performed in response to approved work requests initiated by all AFHRL divisions. In addition to processing these work requests, the Division performs a quality review of all work performed to ensure complete and accurate results.

FY84 Milestones: More than 200 data processing work requests were received in FY84. The following examples of R&D efforts illustrate the diversity of the work performed.

Missile Officer Selection Studies: Data analysis support was provided in four related projects designed to investigate improved selection pro-

cedures for officers in the Missile Operations career field. In the first two projects, data were assembled for Missile Launch School students who were in training between June 1979 and September 1983. Preliminary descriptive statistics, distributions, correlations, and regression model exploration were performed to analyze training attrition and the relation between training performance criteria and subtests of the Air Force Officer Qualifying Test (AFOQT). The final two projects focused on Minuteman students who were commissioned through Officer Training School (OTS) or Air Force Reserve Officer Training Corps (AFROTC). Based on these personnel, regression analyses were performed to develop an optimally weighted composite of AFOQT verbal and quantitative subtests for use in screening Minuteman missile operations officers. Seven training criterion were analyzed, and optimal cutting scores for the verbal and quantitative AFOQT subtests were determined.

Experimental Testing Facility

Experimental Test Facility Support: The AFHRL Experimental Test Facility uses 30 TERAK computers to collect perceptual-motor and cognitive performance data with Basic Aptitude Tests (BATs) administered to candidates for pilot training. The results from the testing sessions are consolidated onto magnetic tape, using a PDP-11/34 computer. The Technical Services Division transfers the data to the Sperry 1100 computer system, checking the files for reasonability, and providing reports back to the test center in a quick-response mode in the event of data transfer problems. In CY84, Air Force Officer Qualifying Test scores were added to the BAT data base, and statistical analyses such as correlations and frequency distributions were produced to aid in evaluating the different tests in the system.

Armed Services Vocational Aptitude Battery (ASVAB): The Technical Services Division performed a variety of analyses and programming activities associated with the implementation of new ASVAB Forms 11/12/13/14. Some of the work accomplished is described below.

A special equating study was performed to correct 1980 National Opinion Research Center (NORC) reference sample scores from speeded subtests that were in error due to the use of non-operational answer sheets. Analyses consisted of identifying discrepancies in scores as a result of the different answer sheets, equating subtest scores from NORC answer sheets and operational answer sheets, developing tables for adjusting NORC scores, and performing regression analyses to evaluate the accuracy of the adjustments.

The study, Evaluation of NORC-Sample Enlistment Qualification Rules--1944 and 1980 Metrics, was performed to compare 1980 score equivalents to 1944 scores for the General Aptitude Index and the sum of the four Aptitude Indices. Using the NORC reference sample of 18 to 23 year old males and females, tables were developed to reflect qualification rates for sex/race subgroups in both metrics.

Other ASVAB support activities included answer sheet scanning and scoring and development of item response data tapes for contractors working on computerized adaptive testing and comparison of ASVAB with other tests. Scanning and scoring along with assorted analyses were also provided for the study, Post-Enlistment Verification of Enlistment Qualifications. This study is accomplished annually in accordance with an Air Force regulation that requires periodic checks of the integrity of the production ASVAB testing program. In the study, response data for samples of retested basic trainees were analyzed to check the incidence and sources of discrepant preenlistment and postenlistment ASVAB scores.

Occupational Research Data Bank: Annual update files were generated for the Air Force Occupational Research Data Bank (ORDB) statistical display system. These files consist of information extracted from the Uniform Airman Record (UAR) file, the Airman Gains and Losses (AGL) file, and the Pipeline Management System (PMS) file for CY82. The total statistical database of the ORDB now has summary tables for 1978 to 1982, consisting of UAR, AGL and PMS statistics and summary counts. Each year of UAR/AGL data in ORDB is based on over 500,000 records for airmen on active duty during the calendar year. The PMS data are based on more than 115,000 records for airmen in technical training during the calendar year. Each annual update adds more than 190 summary and statistical tables to the statistical database.

Air Force Officer Qualifying Test (AFOQT): Continuing research dealing with the AFOQT resulted in a variety of processing/analysis requests involving such areas as (a) psychometric analyses to compare the AFOQT with the Scholastic Aptitude Test and the Air Force Reading Ability Test, (b) evaluation of the impact of AFOQT verbal and quantitative "cut-score" requirements set by the Officer Training School, and (c) exploratory analysis of a new navigator screening composite made up of subtests of the AFOQT. An additional project in response to a request from the Directorate of Personnel Plans was also processed to determine the number of AFOQT examinees during FY75 to FY83 who met or exceeded minimum qualifications for selection into pilot, navigator, or precommissioning training.

Strength and Endurance: To assess physical job requirements for enlisted Air Force specialties, the Manpower and Personnel Division collected task-level physical demand estimates from 6300 supervisory personnel in over 150 Air Force specialties. This survey effort amassed a large collection of data with a high level of detail and a complex computer file structure. To facilitate the statistical analysis of this survey data, the Technical Services Division performed analysis of the survey data files and developed design plans for assembling the data into a single master file with a high level of fidelity and an efficient format for carrying out the needed statistical analyses. In early FY85, development of the master file will be completed, and standardized Sperry runstreams and programs will be developed to produce statistical analyses of the survey data for all specialties.

Air Force Recruit Assignment Preferences Studies: The Technical Services Division provided data processing and analysis support for two projects for the Directorate of Personnel Plans regarding assignment preferences of male and female Air Force recruits. In the first effort, historical recruiting data from 1982 and 1983 were obtained from PACE-PROMIS personnel files, and summary reports were developed reflecting Air Force specialty preferences by sex. Additional reports were developed with the preferred specialties collapsed into 20 Department of Defense (DoD) job groups. In the second effort, occupational preferences were examined within a 57,000-case sample and were used for validation of the Vocational Occupational Interest Choice Examination. Assignment preference information was derived for all sample cases in the validation study.

Air Force Reserve Officer Training Corps (AFROTC) Selection Validation: Data processing and analysis support was provided in a project to evaluate procedures used for identifying AFROTC candidates (in calendar years 1978 to 1981) under the Weighted Professional Officer Selection System (WPSS). Much of the work consisted of assembling performance criteria data for the targeted personnel from numerous sources to obtain performance information prior to commissioning and at selected career points subsequent to commissioning. In the final effort the database includes information from WPSS data files, the AFROTC Contract Loss File, Air Force Officer Qualifying Test files, student performance rating files, technical training files, and Officer Effectiveness Report files. Computer products in the form of rosters, distributions, correlations, and regression analyses were provided.

Pilot Screening Research: Extensive database development activities have been accomplished to support ongoing pilot screening R&D efforts. Currently, the pilot screening database is comprised of 11,532 subjects and contains information from a variety of sources: Uniform Officer Record File, Flight Screening Program results, Air Force Officer Qualifying Tests, Undergrad-

uate Pilot Training summaries and detailed maneuver grades, and results from three testing devices (Psychomotor, Zero Input Tracking Analyzer, and the Automated Pilot Aptitude Measurement System). The database will be updated every fiscal year-end and augumented with additional pilot training data to allow tracking of subjects through various phases of training.

Non-Appropriated Fund (NAF) Reduction-in-Force Policy Study: Statistical analyses were performed in support of an effort to validate the reduction-in-force policy used by Civilian Personnel Offices for Nonappropriated Fund (NAF) employees. Retainability rankings for a sample of employees provided by an 11-member NAF policy board were analyzed to derive a weighted composite of selected factors that could be used to approximate the consensus retainability policy of the board members. The statistical analyses for the effort included development of a policy equation for each board member, a grouping analysis of the board member policy equations to identify the consensus policy, and development of a system of factor weights for operational use.

Utilizaton: Statistical and data processing products provided to AFHRL scientists were used in support of a broad spectrum of Laboratory R&D projects. Much of FY84 computational work was in support of the Laboratory's Manpower and Force Management Thrust and included analy- ses of enlisted and officer qualification tests, pilot and missile officer selection R&D, occupational analysis and assessment of physical job requirements for enlisted Air Force specialties, and other projects dealing with personnel selection and assignment procedures.

Benefits: Computational results obtained in these projects provide the basis for reducing attrition in missile officer training, reduced attrition in Undergraduate Pilot Training, and better assignment of personnel to jobs with specific aptitude and physical requirements.

Title: SUPPORT TO OUTSIDE AGENCIES

AFHRL Contact: Doris E. Black
AFHRL/TSO
Brooks AFB, TX 78235-5000
Commercial (512) 536-3928
AUTOVON 240-3928

Description: The Technical Services Division provides statistical services and data processing support to approved agencies outside AFHRL. Work requests are initiated on behalf of the outside customers and then processed in the same manner as those for the AFHRL divisions.

FY84 Milestones: During FY84, 19 projects were performed for outside agencies. The following items illustrate the range of these activities.

Identification of Air Force Female Vietnam Veterans: The Technical Services Division provided the Army Agent Orange Task Force and the Centers for Disease Control of the Department of Health and Human Services with information about Air Force female personnel who served in Vietnam from 1964 to 1973. The information was requested to aid in determining the feasibility of including women in a study of Vietnam veterans mandated by Congress. Data processing and analysis activities consisted of identifying duty locations in Southeast Asia during the 1964 to 1973 time period, locating records from pertinent historical airman and officer strength files for females assigned to those duty locations, and preparing personnel rosters and computer reports containing requested summary information. Over 135 million computer records were screened during this effort, and a total of 771 female officer and enlisted personnel assigned to 33 units in Vietnam were identified.

Project Capture Enrichment Study: A large-scale data file was developed for the Personnel Procurement Directorate of the Air Force Manpower and Personnel Center to assist with the enrichment of the Project Capture database used by the Air Force Recruiting Service for screening prior

service applicants. Information on over 300,000 airmen who separated from the Air Force from June 1978 through September 1983 was assembled from the AFHRL Airman Reenlistment and Loss File. The separations data were then supplemented with additional data elements from the AFHRL historical airman strength files to provide background information reflecting military credentials.

Recruiting Information on FY83 Officer Gains through Officer Training School: The 3546th USAF Recruiting Squadron was provided with recruiting information on FY83 Air Force officer gains through Officer Training School (OTS) who had engineering or psychology degrees from institutions within and outside the Southwest recruiting area. The effort was conducted as part of a recruiting market penetration analysis and was designed to investigate how frequently graduates in technical fields, such as engineering and psychology, move to other locations for work, after completing their degrees, and then make the decision to enter the service from the new locations. Data analysis support provided by the Technical Services Division consisted of obtaining pertinent data from officer strength files and OTS master files and producing assorted rosters and summary reports reflecting academic majors, institutions, recruiting areas, and time lapses from college graduation to entering active duty.

Evaluation of Screening Program for Preservice Drug Abusers: Data processing and analysis support was provided to the 3507th Airman Classification Squadron, Lackland AFB. The objective was to determine whether pres ice drug abusers screened and retained by the Squadron's Special Counseling Section are involved in more drug-related incidents than airmen who are not screened. The Technical Services Division assisted by identifying a matched "control" sample for approximately 1300 "experimental" sample airmen who were screened by the Special Counseling Section and then assembling needed background data from master personnel files. Comparative analyses were performed, examining several attributes of the two groups of airmen.

Transfer of Historical Data: The Technical Services Division provided data from several historical personnel databases to staff offices of the Directorate of Personnel Plans at Air Force Headquarters, the Air Training Command Assistant Chief of Staff for Commissioning Programs, and the Air University. The Directorate of Personnel Plans received 298,846 records reflecting initial skill technical training completed/terminated by enlisted personnel during FY79 to FY83. The Air Training Command received Officer Training School Master files covering classes 7901 to 8408 and a copy of the Flying Training Transaction Collapse Master File containing data for all flying trainees from June 1963 to September 1983. The Air University received selected data elements for 295,138 officers who held the rank of major or above from 1975 through 1982.

Transfer of Technology: Computer software developed and maintained by the Technical Services Division was provided to other government agencies with the approval of the Air Force Systems Command. The Comprehensive Occupational Data Analysis Programs system was provided to the Australian Department of Defense. Also, the U.S. Department of Agriculture, the Navy Regional Data Automation Center, and Headquarters U.S. Air Force in Europe were provided copies of the AFHRL-developed, general-purpose, software libraries of over 300 programs. Since the 1973 implementation of the Sperry 1100 at AFHRL, the Technical Services Division has developed an extensive library of computer programs, much of which has potential for use at other government Sperry sites. The software provided to these government agencies will prevent duplication of programmming tools, increase the efficiency of new program development efforts, and enable the data processing staff to better utilize the Sperry equipment.

FACILITIES, SYSTEMS, FUNCTIONS

COMPUTER FACILITIES

The Technical Services Division of AFHRL manages and operates a Computer Center which includes a large-scale, general-purpose Sperry 1100 computer system to support research and development programs of the Air Force Human Resources Laboratory (AFHRL), the Aerospace Medical Division (AMD) at Brooks AFB, the Occupational Measurement Center and the Air Force Manpower and Personnel Center (AFMPC) at Randolph AFB; a Digital Equipment Corporation VAX 11/780 computer system to provide Automated Management Information Systems in support of R&D projects within AFHRL and to provide an interface with the Defense Data Network (DDN); and a Wang Laboratories VS 90 computer system to provide office automation support within AFHRL.

The Computer Center includes a magnetic tape library which houses between 15,000 and 20,000 active tape reels. These tape reels contain historical data from Air Force personnel files dating back to the mid-1950s. The library contains 850 unique data files that are available for use by scientists in the research and development projects of the Laboratory.

The Sperry 1100 computer system provides the computer capability needed to support the R&D projects of the Laboratory. The Sperry 1100 system supports major programming languages including FORTRAN, COBOL, and data base management systems including Sperry's DMS 1100 and System 2000. There are over 300 people authorized use of the 1100 System via dial-up telephone lines, dedicated telephone lines (servicing Williams AFB/and Randolph AFB) and direct connected terminals at AFHRL. Sperry 1100 users include AFHRL and AMD scientists and contractors, as well as survey analysts from OMC and AFMPC.

The VAX 11/780 computer system, using the Oracle Data Base Management System (DBMS), provides Automated Management Information Systems (MIS) in direct support of R&D projects within AFHRL. Presently, personnel throughout AFHRL use the System 2000 DBMS on the Sperry 1100 system to support MIS requirements. All MIS presently on the Sperry 1100 computer will be transitioned to the VAX 11/780.

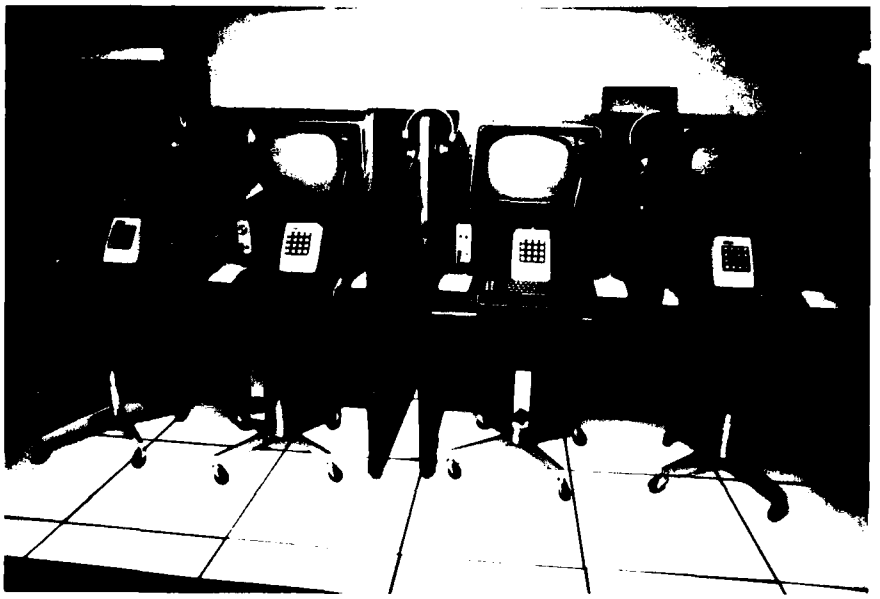
The Wang VS 90 computer system provides office automation support within AFHRL. This system provides local automated word processing capability and electronic mail service to the remote AFHRL divisions and HQ AFSC. The Wang terminals and printers located throughout AFHRL (Bldg 578) allow users to create, edit, reuse and print research reports, correspondence, etc., and store documents on magnetic disks for later retrieval as needed. The electronic mail function allows transmission of correspondence, research reports, etc., between all AFHRL divisions and HQ AFSC. Long distance telephone calls are routinely made to each remote location and mail items are distributed. Urgent correspondence is handled on a priority basis, with delivery generally occurring within 15 minutes.

AFHRL's General-Purpose Sperry 1100 Computer

In addition to the central computing facility at Brooks AFB, AFHRL has computer resources at Williams AFB, Lowry AFB, Wright-Patterson AFB, and Lackland AFB. The Automatic Data Processing Equipment (ADPE) at Williams AFB consists of nine Systems Engineering Laboratory (SEL) 32/75 computers, three SEL 8600 computers, one SEL 7200 computer, a Sperry 400 terminal system consisting of two CRT terminals and a printer, a Sperry 700 remote batch terminal, and a Sperry 200 terminal and printer. The ADPE at Williams AFB supports the Advanced Simulator for Pilot Training (ASPT), which in turn supports the primary mission of AFHRL Operations Training Division.

Located at Lowry AFB is a Control Data Corporation CYBER 170. This system is used to develop programs for computer-managed instruction and computer-assisted instruction. The system is used as a research tool for the development and evaluation of computer-based education and training.

Located at Wright-Patterson AFB is a DEC PDP 11/45 System which supports a research and development project for ground operations training. The objectives are to reduce training time and to improve performance of weapons directors in missile and space command and control systems. The project will use a special-purpose, high-resolution, color raster scan, three-dimensional graphics display system.



Experimental Facility

EXPERIMENTAL FACILITY

In-house research uses the Experimental Testing Facility at Lackland Air Force Base in San Antonio, Texas, which was developed through joint sponsorship by the Air Force Office of Scientific Research and the Air Force Human Resources Laboratory and is maintained by AFHRL personnel. The facility includes 30 testing station carrels for use in basic research on learning abilities. Each station consists of a TERAK 8510a microcomputer system with TERAK 7512 dual-density disk drives for test item and response data storage, a standard keyboard for response entry, and a medium resolution (320 x 240 pixel) TERAK 8604 black-and-white video monitor for timed presentation. Stations are also equipped with headphones, each connected to a multi-channel broadcasting audio recorder system, and can thus be used as dichotic listening devices. The testing stations are in the process of being upgraded with multi-event millisecond timers, joysticks, external keyboards, and computer-controlled voice-sound input. The microcomputers are wired into a network system, for the purpose of data transfer and general station-to-station communications, thus making possible studies involving cooperative and competitive activities. Long-range plans call for video input so as to facilitate studies involving dynamic graphics and realistic visual displays. Aircrew selection and classification research is also supported at this facility through experimental aptitude testing using 10 non-portable PDP 11/04-based computer test stations and 11 ALCYON microcomputer-based portable test stations. These devices administer the Basic Attributes Test (BAT), a battery of 14 automated tests of psychomotor and cognitive abilities. Additionally, each test unit also supports the necessary utility functions needed to provide autonomous testing capability.

AFHRL Meeting Via Teleconference

AUDIO AND VIDEO/GRAPHICS TELECONFERENCING

Since July 1984, all of the remote divisions of AFHRL and the headquarters are equipped with a video/graphics teleconferencing system. This system is capable of creating, storing, and retrieving digital color imagery consisting of text, graphs, and/or photographs and subsequently displaying these images locally on large screen display systems or on color monitors. In addition, it is capable of conducting a full-scale color teleconference between two locations using a normal telephone access line to transmit only the control functions since all the charts are prepositioned prior to the teleconference. A second telephone line is required during a teleconference to transmit the voice. In the very near future, it will be possible to link the headquarters and all the remote divisions together simultaneously, thereby providing for a fully interactive, multi-point video/graphics teleconference.

Airman Developing Graphs by Computer

LABORATORY OPERATIONS CENTER

The Laboratory Operations Center (LOC) is the focal point for collecting and displaying data used in the management of the AFHRL technical program. The software for input of data at the source has been completed. All of the divisions are now on line to input and retrieve MASIS, JOCAS, and TDY source data for MIS products. Automated data transfer to HQ AFSC is being done for MASIS data, with similar transfer of other information in the future. Personnel throughout AFHRL retrieve data and produce reports using the AFHRL database and System 2000. The LOC can provide various types of color output, such as textual slides, pie charts, bar graphs, and line graphs, suitable for viewgraph and 35mm projection.

JOB ORDER COST ACCOUNTING SYSTEM

The Job Order Cost Accounting System (JOCAS) consists of more than 80 interactive computer programs used by the Air Force Systems Command for the mechanized accounting of all its resources. All funds and labor are channelled into this system by the base finance units and the laboratories. AFHRL receives over 40 JOCAS reports monthly detailing the resources expended by current month, as well as by year-to-date accumulations. Each work unit is identified by a unique job order number and all resources directly supporting a particular work unit are charged to that unique number.

One of the primary uses of JOCAS is to identify and track all reimbursement earnings to assure that the reimbursement programs are earned fully, that the proper organization is billed for these earnings, and that these earnings are credited to the unit which earned them. Various JOCAS reports are analyzed to detect trends in the use/expenditure of AFHRL manpower and funds. Studies are conducted to identify AFHRL direct and indirect labor trends for total Laboratory manning, as well as for scientific and engineering personnel and technicians. Similarly, studies identify the funds expenditures in various categories, such as customer, technical planning objective, direct, indirect, and systems. These studies show historical trends over several years and provide valuable management information for optimizing the use of AFHRL resources.

MANAGEMENT AND SCIENTIFIC INFORMATION SYSTEM

The Management and Scientific Information System (MASIS) is designed by and for research and development program managers in the Air Force Systems Command. The system integrates financial, technical program, and procurement status data into a single database. At AFHRL, data are collected from the AFHRL database for the primary input into the MASIS.

Work unit data in MASIS are recorded and retained at the funding action level. For in-house work, the funding action is initiated for the annual estimate of resources. Estimates are updated to actual amounts at the close of each fiscal year from data extracted from the Job Order Cost Accounting System. Funding action for a specific contract or grant is linked to the basic contract or grant record. The basic contract and all follow-on contracts or grants that are a part of the same work effort are mechanically linked together.

OFFICE AUTOMATION

Office automation within AFHRL is currently supported by a Wang Laboratories VS-80 computer. This equipment provides an automated word processing capability, as well as electronic mail service among AFHRL Wang users. Computer terminals and printers located throughout AFHRL allow users to create, edit, revise, and print correspondence. In the past, these functions normally were done with typewriters. These devices greatly increase the ease and efficiency with which this correspondence is handled. In addition, all correspondence is filed on magnetic disks for later retrieval and use as needed or for deletion when no longer required. The electronic mail feature allows transmission of correspondence to and from any of the AFHRL divisions. At preset times during the work day, long distance telephone calls are automatically made to each remote location and any mail items are distributed. Mail items from the remote locations are also picked up at those times and delivered to the proper recipient, whether at Brooks AFB or at another remote location. Urgent correspondence is handled on a priority basis, with delivery to the receiving system generally occurring within 15 minutes. These features of the office automation system greatly reduce the paperwork burden of AFHRL personnel in accordance with the Paperwork Reduction Act of 1980 (PL-96-511) and streamline the many administrative tasks necessary in today's offices.

AFHRL Technical Library

LIBRARY FACILITY

The services provided by the AFHRL library include the acquisition of books, journals, and other library materials. These services are provided for the command staff offices and the divisions on Brooks AFB, as well as for divisions and offices located in other geographical areas.

Library holdings at the end of FY84 were 13,006 books and bound volumes of journals, and 11,878 technical reports. This represents the addition of almost 1,000 books and 2,000 technical reports during the year. The library subscribes to 499 journals of which 41 are for the Operations Training Division, Williams AFB, and 60 for the Training Systems Division, Lowry AFB. Office collections at the Divisions include 437 titles at Williams, 263 at Lowry and 168 at Wright-Patterson.

During FY84, AFHRL library personnel answered 3,123 reference requests, provided 937 photocopies, and performed 100 bibliographic searches in support of AFHRL R&D programs. The library circulated a total of 24,412 books and nonbook materials (17,889 books, 4,990 journals, 1504 technical reports and 29 audio-visual cassettes). In addition, the library loaned 186 items to other libraries and borrowed 82 on interlibrary loan.

The library continued its policy of not binding journals available on 16mm microfilm and now has a collection of 1,624 cartridges.

The library had online access to Dialog Information Services, Inc. at Palo Alto, California, the Defense RDT&E On-Line System, at Alexandria, Virginia, and OCLC (Online Computer Library Center, Inc.) at Dublin, Ohio. In addition to the cataloging and interlibrary loan functions of OCLC, the library initiated a project of entering its journal records online. These records will be incorporated into the CORAL Union Lists of Serials.

The library participates in three local consortia--the Council of Research and Academic Libraries of San Antonio (CORAL), the Health Oriented Libraries of San Antonio and the San Antonio Area Online Users Group.

TRAINING
SYSTEMS
DIVISION

TRAINING SYSTEMS DIVISION

The Training Systems Division located at Lowry AFB, Colorado, has the primary objective of developing improved methods and strategies for initial skills development and enhanced job performance by upgrading individual and unit training. Specific technical objectives include development and demonstration of improved training methods, instructional and learning strategies, and training design and evaluation techniques. Other objectives relate to the development of computer-based training and job-aiding systems including transportable computer software to support instructional systems, maintenance simulation systems, and the application of intelligent systems technology to training and job-aiding.

The Training Design and Delivery Thrust is structured to develop, integrate, and demonstrate improved training systems and technologies for both individual on-the-job and unit training programs. The thrust objective is addressed through work in two subthrusts: Skills and Performance Specification Systems and Training Management and Delivery Systems.

Colonel Graham P. Crow
Division Chief

Dr. Joseph Yasutake
Technical Advisor

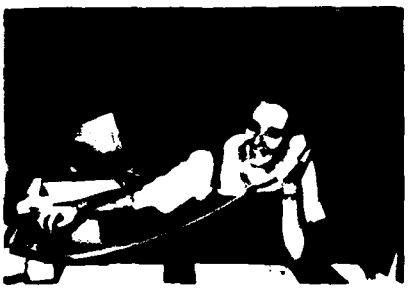
The Skills and Performance Subthrust incorporates R&D on the content and process of instruction; instructional and learning strategies; definition of training and performance requirements; performance assessment, evaluation, and training quality control; cognitive and motivational aspects of instruction; and artificial intelligence applications to instructional delivery and support.

The Training Management and Delivery Subthrust addresses R&D on development and management of instruction for both formal and on-the-job training. Included are efforts pertaining to the use of computer-aided/managed instruction and maintenance simulation. Overall, the Training Systems Division has an applied research focus, with exploratory development work occurring in both Division subthrusts. The basic research activities of the Division are oriented mainly toward skills acquisition, while advanced development work falls mainly in maintenance simulation and on-the-job training.

COMMAND STAFF PERSONNEL

Mr. Robert L. Eady
Chief, Executive Support Service

Dr. Herbert [illegible] Clark
Director, Plans and Programs Office



PLANS AND PROGRAMS OFFICE

The Plans and Programs Office plans, implements, and manages the conduct of the AFHRL Research and Development (R&D) program, and is responsible for promoting the transition of R&D technologies to operational organizations. Staff members publish all planning and programming documents, prepare budget submissions for higher headquarters, and perform long-range planning to satisfy Air Force operational needs. The office provides the resources required to execute the Laboratory R&D program and monitors the progress of all contract and in-house work.

The Director of Plans and Programs is responsible to the AFHRL Commander for the proper operation of the Plans and Programs Office and bears responsibility for the Laboratory's staff mission in plans and documentation, operations, programs, financial management and technology transition. The Director serves as a member of the Corporate Planning Group and its Executive Committee.

ANALYSIS AND EVALUATION OFFICE

The Analysis and Evaluation Office at AFHRL is responsible for the planning and execution of studies to evaluate potential benefits and costs for major AFHRL Research, Development, Test, and Evaluation (RDT&E) programs. Through direct interaction with project managers and Air Force users, plans are identified for the development, testing, acquisition and deployment of products and systems. Studies conducted by this office provide the AFHRL Commander and the Plans and Programs Office with information concerning potential force-multiplier effects and life-cycle benefits and costs which are anticipated from the investment of resources in major programs.

The office provides guidance to AFHRL Divisions in the development and estimation of research and development costs, and has prepared a cost estimation regulation which will promote standardization and increased accuracy of estimated contract costs. A cost estimation handbook now being prepared will identify relevant cost categories, factors, and procedures to be used in the cost estimation process. Training will be conducted for Laboratory professionals in the use of this handbook. The staff is also responsible for the conduct of Front End Analyses (FEAs) on incoming Requests for Personnel Research (RPRs) and new start Program Objective Memorandum (POM) submissions in 6.3 advanced development programs. FEA results will be an additional source of information to be considered in reviewing RPR proposals and 6.3 new starts. The staff is responsible for the conduct of special studies which focus on Laboratory operations. One study compared costs with measureable benefits for office automation word processing equipment, and demonstrated the cost effectiveness of the current system. Using results of this study, a request for Productivity Investment Funds was developed and justified. These funds, if approved, will accelerate delivery and use of word processing equipment by the professional and technical staff of the Laboratory.

The Director of Analysis and Evaluation is responsible to the AFHRL Commander for the proper operation of the Office and bears responsibility for the Laboratory's staff mission in analysis and evaluation of planned and ongoing RDT&E. The Director also serves as a member of the Corporate Planning Group and its Executive Committee.

EXECUTIVE SUPPORT OFFICE

The Executive Support Office develops and implements policies, procedures, and standards relating to administration management and practices, military and civilian personnel and manpower actions, and materiel actions. The Office provides staff guidance, assistance, and surveillance over other echelons in areas of functional responsibility for the Laboratory Commander. The office staff evaluates administration, personnel, and materiel procedures in other functional areas within the Laboratory and operates the following programs: manpower and organization; reports management; document security; military and civilian personnel administration (including training programs); and organizational supply. Further, the Executive Support Office is the principal focal point for host-tenant support agreements for the Laboratory and off-base divisions; represents the Laboratory in dealings with other agencies and higher headquarters in all areas of functional responsibilities; and serves as focal point for Inspector General visits and reports.

Colonel Tyree H. Newton
Vice Commander

The Vice Commander assists the Commander in the performance of his command function and commands the Laboratory in the absence of the Commander. The Vice Commander chairs the Laboratory's Corporate Planning Group (CPG) and the Corporate Planning Group Executive Committee (CPGEC).

The CPG is responsible to the Commander for recommendations and priority assignments on laboratory policy, short- and long-term goals, and overall mission and thrust alternatives. The CPG consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, the Division Chiefs, and the Executive Officer (Recorder). The CPG meets at least once annually.

The CPGEC consists of the Vice Commander, the Chief Scientist, the Directors of Headquarters Staff Offices, and the Executive Officer (Recorder). The CPGEC acts for the CPG between CPG meetings and meets at least once monthly.

Normal functions of the CPGEC are the following:

1. Upon the Commander's approval, the committee disseminates policy or guidelines to, or requests reports or information from, any AFHRL organization element or other offices and agencies.

2. The committee reviews the Technical Advisory Board recommendations regarding the Laboratory's Research, Development, Test and Evaluation (RDT&E) program for compliance with policy, goals, objectives, and priorities.

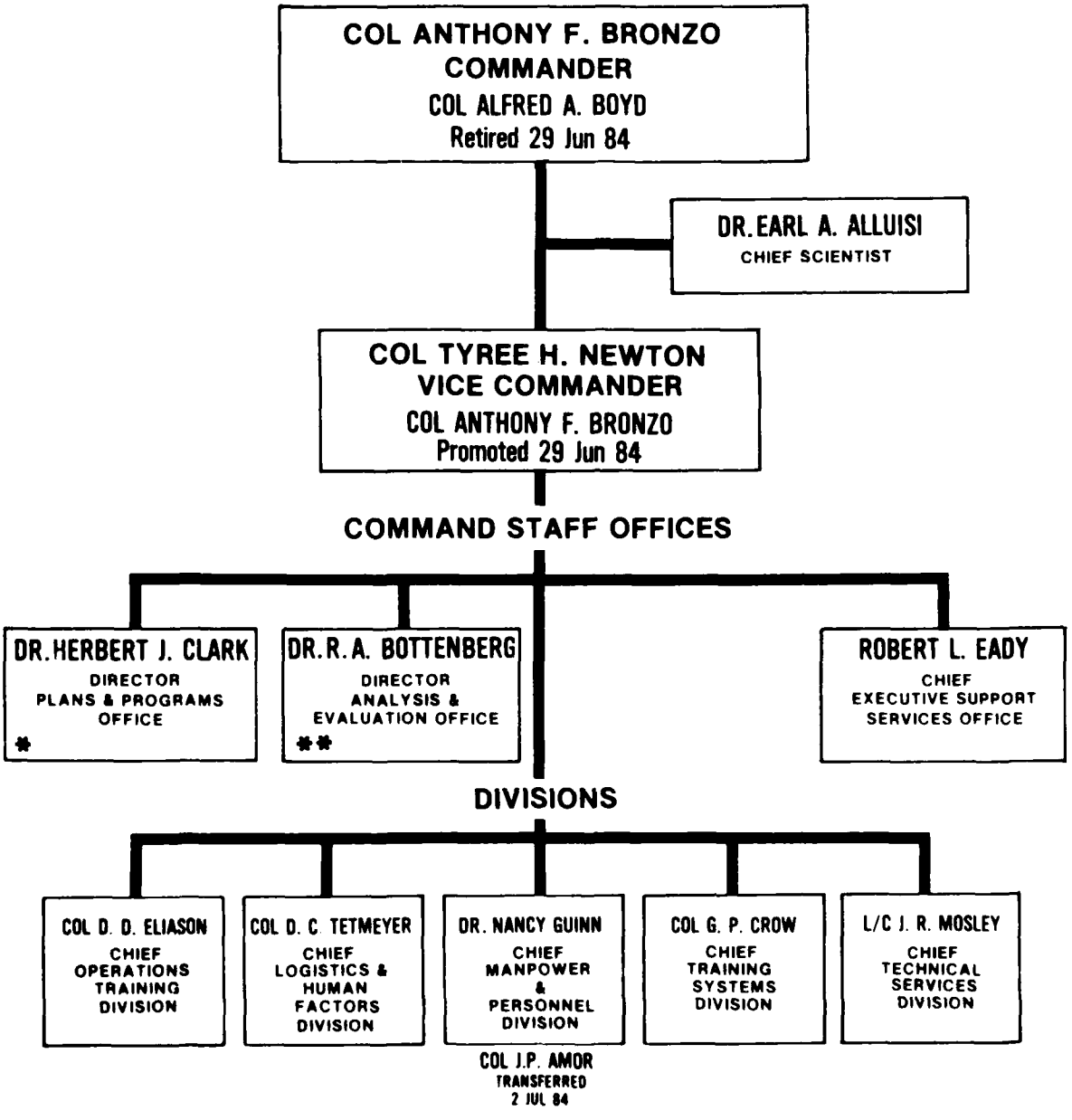
3. It forwards recommendations regarding the RDT&E program to the Commander, with comment.

4. Upon the Commander's approval, it forwards the Commander's approved RDT&E program to the operating RDT&E divisions and staff offices.

5. Finally, the committee makes recommendations to the Commander for assignments of divisional and staff office responsibilities and added efforts, including new technical thrusts.

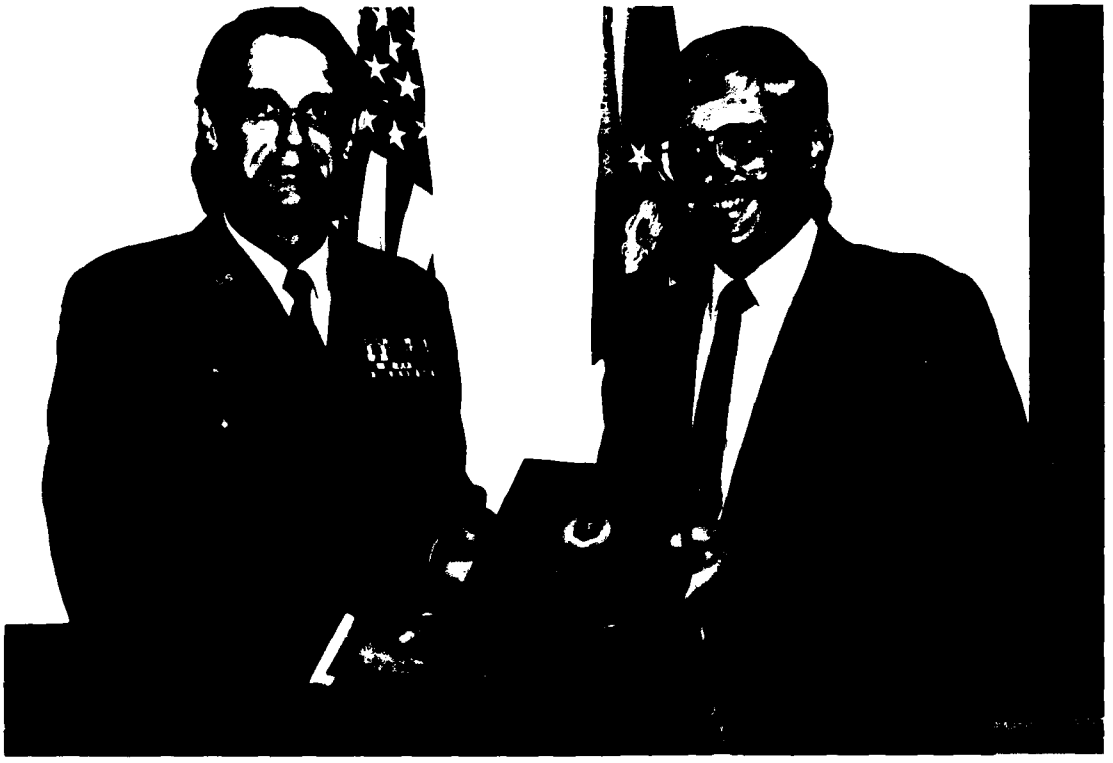
AIR FORCE HUMAN RESOURCES LABORATORY

ORGANIZATION



* 15 JAN 84 THE APPLICATIONS AND LIAISON OFFICE WAS INTEGRATED WITH THE PLANS AND PROGRAMS OFFICE

** 10 DEC 84 DR R. A. BOTTENBERG BECAME CHIEF OF TECHNICAL SERVICES DIVISION, MAJ THOMAS A. BOYNTON BECAME DIRECTOR OF PLANS & EVALUATION OFFICE



Dr. Hendrick W. Ruck Receives the FY84 AFHRL Management Award

AFHRL MANAGEMENT AWARD WON BY DR. RUCK

Dr. Hendrick W. Ruck was awarded the AFHRL Management Award for outstanding R&D program management in the Manpower and Personnel Division. Dr. Ruck is the Chief of the Job Requirements and Training Function in the Force Utilization Branch and has been responsible for the R&D management of the Basic Skills, Training Decisions System, Aptitude Requirements and Aptitude Change Effects on Training and Recruiting, Officer Job Measurement Methodology, Strength and Stamina Requirements, Officer Education Profiles, and Interdivisional Task Identification and Evaluation System projects.

As team leader of the Task Oriented Basic Skills Assessment and Enhancement project, Dr. Ruck managed a seven-million-dollar R&D program that (1) will deliver phased exploratory and advanced development findings such that the exploratory findings can be used to make investment strategy decisions before significant commitment to advanced development despite the budget-driven tight scheduling of the two; (2) will provide user-oriented products incrementally; and (3) is designed for effective management control. The program management is a model for other multi-million-dollar research and development efforts.

Robert Deem Accepts D. B. Haines Award

D. B. HAINES AWARD WON BY ROBERT DEEM

Mr. Robert Deem, Acquisitions, Logistics Branch, Logistics and Human Factors Division, was granted the Donald B. Haines award for the period March 1978 through December 1983 for outstanding accomplishments in completing the development, evaluation, and implementation of the Unified Database software system for logistics information. Mr. Deem conceived the idea of a computerized interactive logistics database system, developed the original plans for a research program, convinced the Laboratory managers of the need for the R&D effort, obtained contract dollar resources and in-house research talent, and managed and directed the entire two-million-dollar effort. He persevered in the face of budget upheavals and management uncertainties and accomplished an outstanding R&D program which today is yielding great payoff to the Air Force.

SPECIAL EVENTS

AFHRL 1990s STUDY

The AFHRL 1990s study was chartered on 22 November 1983 by Colonel Alfred A. Boyd, Jr., then AFHRL Commander, to assess and make recommendations on AFHRL functions and organization to meet future AFHRL mission requirements. The goal of the study was to ensure that AFHRL is structured and organized to make the greatest contribution to the Air Force Systems Command mission now and in the future as projected by the AFSC 1990s and HQ AFSC 1990s studies. The conclusions and recommendations, which represent the collective judgment of many persons of considerable talent with a wide range of expertise, provide a road map for the future.

Part of Study Group at Work

Dr. Kantor Receives Dan Berkant Award

DR. KANTOR WINS DAN BERKANT AWARD

Dr. Jeffrey E. Kantor, Chief of Aircrew Selection and Classification Research, received the 1984 Dan Berkant Award recognizing outstanding civilian service to the achievement of the USAF mission. Because of Dr. Kantor's efforts, a new system for pilot selection is underway, which will integrate information about pilot candidates' psychomotor skills with existing selection decision variables.

Preliminary results indicate that the integration of these measures of perceptual-motor skills with the existing decision variables could reduce pilot training attrition by 4 to 5 percentage points. Approximately 1900 pilots are trained annually and the average cost of a student pilot dropping out of flying training is $68,000. A conservative estimate of 4% attrition reduction would result in a cash savings of over 5 million dollars annually, using these new selection techniques, if they prove upon further research to be indeed as good as they first appear.

COLONEL BOYD AWARDED THE LEGION OF MERIT

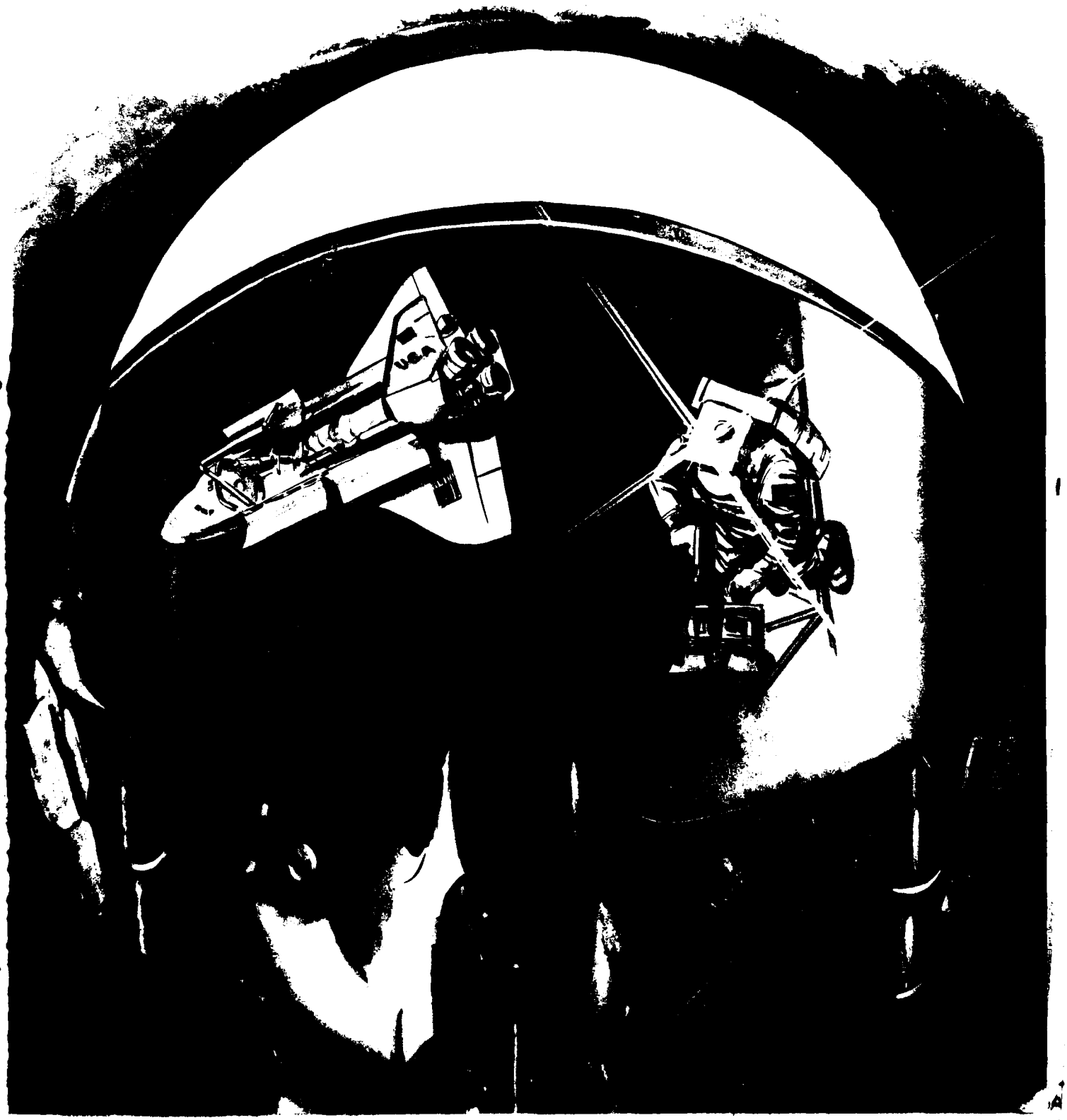
Major General John W. Ord presented the Legion of Merit to Colonel Alfred A. Boyd, Jr., on 27 February 1984. This honor was given Colonel Boyd in recognition of his outstanding service to the United States as Director of Electronics and Space Technology and as the Assistant Director of Laboratories, Headquarters Air Force Systems Command, Andrews Air Force Base, Maryland, from 22 January 1982 to 31 March 1983.

COLONEL BRONZO ASSUMES AFHRL COMMAND

AFHRL CHANGE OF COMMAND

Colonel Anthony F. Bronzo, Jr., assumed command of AFHRL June 29, 1984, in a change of command ceremony held in conjunction with the retirement of Colonel Alfred A. Boyd, Jr. Colonel Boyd had been AFHRL Commander since April 29, 1983. Colonel Bronzo has served the Air Force in a variety of assignments: in the Air Force Contract Management Division, as a Procurement-Production Officer at Rocketdyne, as AFSC Assistant for Social Actions, and as a Management Assistant to the Air Force Inspector General. In 1976, he was assigned as the Executive Officer to the Commander, Air Forces Korea at Osan AFB. Returning to the United States in August 1977, he attended the Armed Forces Staff College, Norfolk, Virginia. Upon graduation in January 1978, he was assigned as the Assistant Chief of Staff, HQ AFSC, until 1981, when he became Executive to the AFSC Vice Commander. Upon graduation from the Naval War College in June 1983, he was assigned as the Vice Commander of the Air Force Human Resources Laboratory and was promoted to the rank of Colonel. His military decorations include the Meritorious Service Medal with three oak leaf clusters, and the Air Force Commendation Medal with two oak leaf clusters.

SPECIAL EVENTS



SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

The Scientific and Technical Information (STINFO) Office plans and directs the STINFO program, including the Technical Library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting research and development. STINFO manages the AFHRL Technical Publications Program, and the AFHRL Publicity/Public Affairs Program, plans and directs the recording of the corporate history, and directs the AFHRL contract data management program. STINFO publishes the AFHRL Annual Report and quarterly AFHRL Newsletter, designs quarterly Technology Base Achievement Flyers, and conducts other AFHRL publicity and public relations activities as required. STINFO also serves as the AFHRL foreign disclosure focal point for determining releasability of military information to foreign nationals. The Office maintains close liaison with foreign technology personnel to ensure that foreign research results are available to Laboratory personnel. Further, the Office serves as the focal point for small business and potential contractor programs, patents/inventions/ copyrights, security and policy review, and other related programs.

TECHNICAL EDITING OFFICE

The Technical Editing Office serves as the focal point for publishing the results of research and development projects. Technical editing, copy editing, and final composition of reports, journal articles, professional papers, brochures, and other documents are accomplished in this office. Guidance is provided to authors and contract monitors to ensure that technical publications comply with Government regulations and professional standards. Further, the office staff composes the camera-ready final copy of reports, tests, survey forms, questionnaires, and brochures; maintains liaison with the Public Affairs Office to obtain clearance for public release of technical publications; coordinates printing requirements; and distributes technical reports, special reports, technical papers, and Quarterly R&D Summary reports.

MANPOWER AND PERSONNEL DIVISION

The main objective of the Manpower and Personnel Division's R&D program is to ensure that the Air Force is able to maintain a quality career force of skilled and motivated people. To help the Air Force meet this objective, the Manpower and Personnel Division of AFHRL has an R&D program designed to improve ways to attract the most qualified individuals, optimally assign them where they will be the most productive, and retain a sufficient number in the career force to meet operational requirements.

To support the Division's major thrust, i.e., Manpower and Force Management, R&D is conducted to develop management tools, procedures and associated technologies to improve procurement, selection, classification, utilization, productivity, and retention of Air Force personnel. Results of this R&D provide a substantive basis for personnel decisions in all phases of the military life cycle.

Dr. Nancy Guinn
Division Chief

Matching the right person with the right job requires an accurate assessment of job demands and individual abilities. The capability to assess an individual's aptitudes, interests, experience and educational background depends on an ongoing R&D program to develop and refine the personnel measurement techniques. As for the job component side, ongoing projects include methods for collecting and analyzing occupational information and the establishment of entry level requirements in terms of aptitude, basic skills, physical strength and stamina, experience, and education. The Division also manages the R&D requirements in support of the tri-service operational testing program - the Armed Services Vocational Aptitude Battery.

Colonel J. P. Amor, Division Chief
(Became AFHRL Interim Vice Commander 2 July 1984)

New R&D efforts focus on the development of analytical tools for efficient management of manpower resources and the identification and forecasting of personnel problems. Computer-based models for skill requirement projections, retention analyses, training decisions and assignment/reassignment actions are being developed. They will update and fill critical gaps in the characterization of the manpower, personnel and training system and will provide a firmer basis for informed policies and effective management decisions.

The Manpower and Personnel Division is also conducting studies to improve personnel utilization, retention, productivity, workgroup effectiveness, and career motivation. In addition, a series of R&D efforts has been initiated to develop on-the-job measures of individual performance. Such measures will provide the legally mandated criterion measures to validate the ongoing selection, classification, and training programs in the Air Force.

MANPOWER
AND
PERSONNEL
DIVISION

OPERATIONS TRAINING DIVISION

The primary objective of this thrust is to develop improved methods and devices for use in aircrew training. The program focuses on assessing the training effectiveness of both current and future approaches to aircrew training. Due to the high cost of aircrew training devices a principal concern is the determination of how much fidelity is required in flight simulators to provide effective training. The thrust consists of two subthrusts: (a) Aircrew Training Systems, and (b) Technology for Aircrew Training Simulation.

The objective of the Aircrew Systems Subthrust is to provide a technology base for training high-level aircrew performance skills through the use of simulated combat environments. Current R&D focuses on the development of training strategies and equipment requirements for use in the training of offensive and defensive tasks using wartime tactics in a realistically modelled combat arena.

Dr. Milton Wood
Technical Director

Colonel Carl D. Eliason
Division Chief

The technology for Aircrew Training Simulation focuses on the development of mission simulator components and techniques that provide greater training capability. It includes the development of advanced computer image generation technology, as well as projection and display technologies to provide full field-of-view visual scenes for use in flight simulators. Outstanding is the development of a simulation capability to train low altitude navigation, targeting infrared tasks.

In the near term, the products of this thrust are providing the equipment and training technologies necessary to teach basic air combat skills and tactics. In the longer term, this thrust will increasingly address the training of those air combat skills required to be successful in specific combat areas and to function effectively as a member of a coordinated combat team. The benefits of R&D success in this thrust will be increased mission readiness for operational aircrews.

OPERATIONS
TRAINING
DIVISION

LOGISTICS AND HUMAN FACTORS DIVISION

The prime objective of the Logistics and Human Factors Division's thrusts is to provide the technology to ensure effective and efficient support of Air Force operations. This support includes planning and management of both material and human resources. Special attention is devoted to maintenance. Also included as an objective is the technology to ensure effective team performance in ground-based systems. The area consists of three interrelated subthrusts: (a) Acquisition Logistics, (b) Combat Logistics, and (c) Command and Control Team Performance Training.

The first subthrust concerns the processes by which support for new systems are designed and planned. It includes the development of new analysis techniques, automation of logistics models and databases, and the development of logistics analysis methods in computer-aided design software. The object is to provide the capability to create supportable designs from the point of inception.

Lt Col Joseph A. Birt
Technical Director

Colonel Donald C. Tetmeyer
Division Chief

The second subthrust is aimed at maintenance capability for deployed combat operations. It includes technology to improve maintenance diagnostics technology for integrated logistics support of weapon systems, improved techniques for planning maintenance and logistics for combat environments, and technology for automating logistics elements such as technical data.

The third subthrust is aimed at improving the performance of non-flying crews, groups, teams and units. Special attention is being given to teams involved in tactical command and control systems to improve the combat readiness of battle staff personnel.

R&D investment in the area of these subthrusts promises unusually high payoff. The potential to reduce cost and increase weapon system supportability is high because this area of technology is quite underdeveloped and initial big-step improvements can be made. The subthrusts have been the subject of unusually high-level interest. Special scientific and operational study groups have stressed the need for increased R&D in the subthrust areas.

LOGISTICS
AND HUMAN
FACTORS
DIVISION

TECHNICAL SERVICES DIVISION

The Technical Services Division operates the scientific data-processing center of AFHRL. The Division develops, maintains, and updates automated personnel and training R&D databases. The Division also provides consultative and programming support in the formulation of studies and the application of statistical techniques in support of other Laboratory Divisions and other Air Force offices. The major organizational elements within the Division are the Computer Programming Branch and the Computer Operations Branch. The Division also includes the Information Resource Management Office, the Scientific and Technical Information Office, and the Technical Editing Office.

The Division operates a large-scale multiprocessor computer facility, including peripheral equipment for support of R&D programs of the Laboratory. Operation of the computer facility includes system support activities such as updates to the operating system, compilers, database management systems, communications, and inter-computer file transfer. The expanding data entry facility and services complement the Laboratory computer facility. The Division also maintains systems to facilitate the rapid transfer of information between the Laboratory's geographically separated Divisions and the Command staff, via electronic mail, and a Laboratory-wide network supporting management information applications.

Dr. Robert A. Bottenberg
Division Chief

The Division directs the Scientific and Technical Information Program, including the technical library, to meet the information needs of scientific and technical personnel in managing, monitoring, and conducting R&D. Further, the Division provides a full range of technical editorial services, and plans and directs the recording of corporate history.

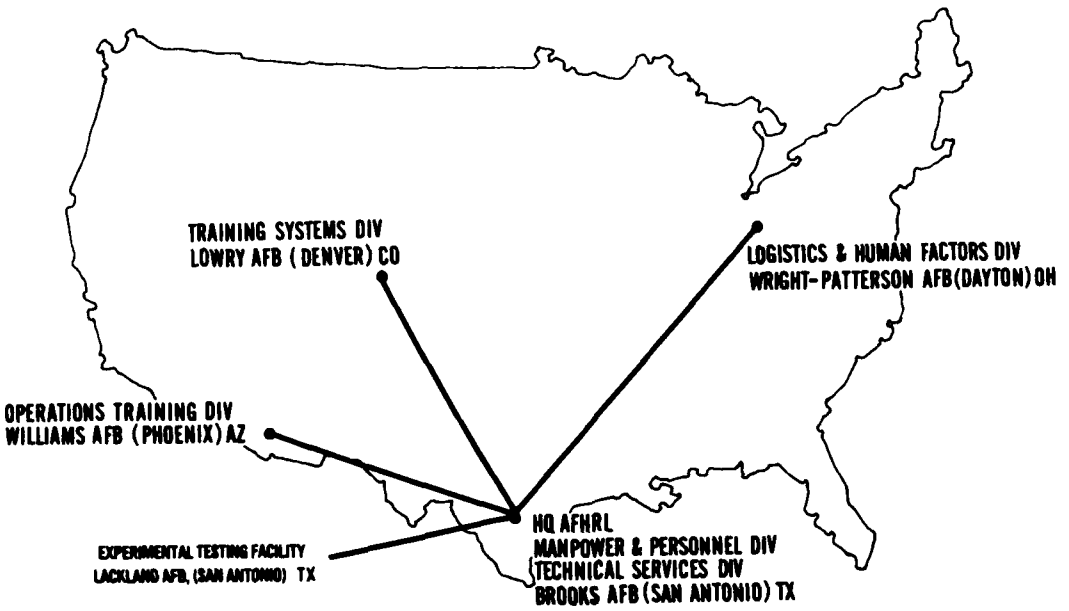
The Division initiated research on a Database Research System that will be a dynamic modular system relating to the total officer and airman force, and will incorporate technology capable of providing timely responses to queries from members of the Laboratory staff and operational personnel of other agencies. The database will include manpower, personnel, and training data, as well as data regarding external factors which influence recruitment, reenlistment and retention of active duty personnel. Work on the officer component has been initiated. Development of the enlisted database will begin in FY85.

The Chief of the Technical Services Division also serves as a member of the Corporate Planning Group and of its Executive Committee.

Lt Col James R. Mosley, Division Chief
(Transferred 10 Dec 1984)

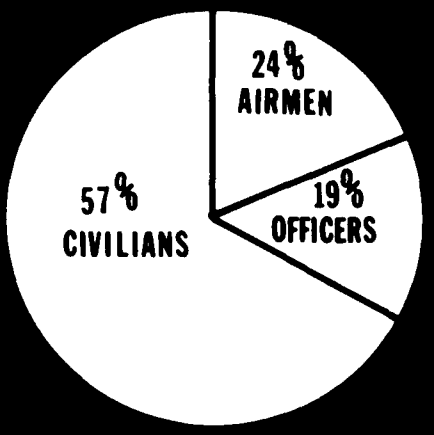
TECHNICAL SERVICES DIVISION

AFHRL GEOGRAPHICAL LOCATIONS



The Air Force Human Resources Laboratory is structured for centralized management and decentralized operation. From Brooks AFB, the command staff manages the R&D programs; the divisions, at their various locations, perform the R&D and support activities. Each R&D division is located in close proximity to major users of its products. The above map depicts the geographical locations of the AFHRL divisions and activities. The Logistics and Human Factors Division is collocated at Wright-Patterson AFB, Ohio, with relevant user commands such as the Air Force Logistics Command, the Aeronautical Systems Division, the Aerospace Medical Research Laboratory, the Air Force Wright Aeronautical Laboratories, the Air Force Acquisition Logistics Division, and the Simulator Systems Program Office. The Training Systems Division is collocated at Lowry AFB, Colorado, with the Air Training Command (ATC) Lowry Technical Training Center. The Operations Training Division is collocated at Williams AFB, Arizona, with an ATC Undergraduate Pilot Training Wing; a Tactical Fighter Wing is at nearby Luke AFB. In San Antonio, Texas, at Brooks AFB, the Manpower and Personnel Division is collocated with the Aerospace Medical Division and the USAF School of Aerospace Medicine. In close proximity is the Manpower and Personnel Center and Headquarters, ATC at Randolph AFB. The Air Force Military Training Center is located nearby at Lackland AFB. The Technical Services Division, also at Brooks AFB, supports the AFHRL scientific and technical programs.

AFHRL RESOURCES



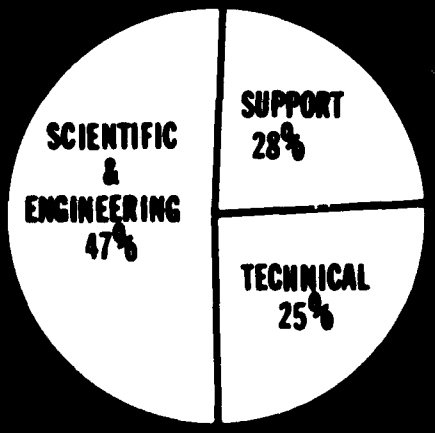
DISTRIBUTION OF AUTHORIZED PERSONNEL FY 84

BY DIVISION

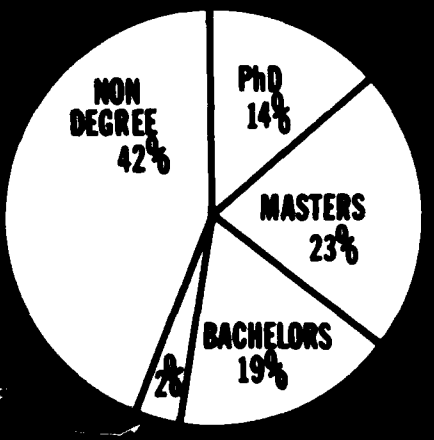
MANPOWER & PERSONNEL	87
LOGISTICS & HUMAN FACTORS	56
OPERATIONS TRAINING	67
TRAINING SYSTEMS	60
TECHNICAL SERVICES	96
HEADQUARTERS	46
TOTAL	412

CLASSIFICATION

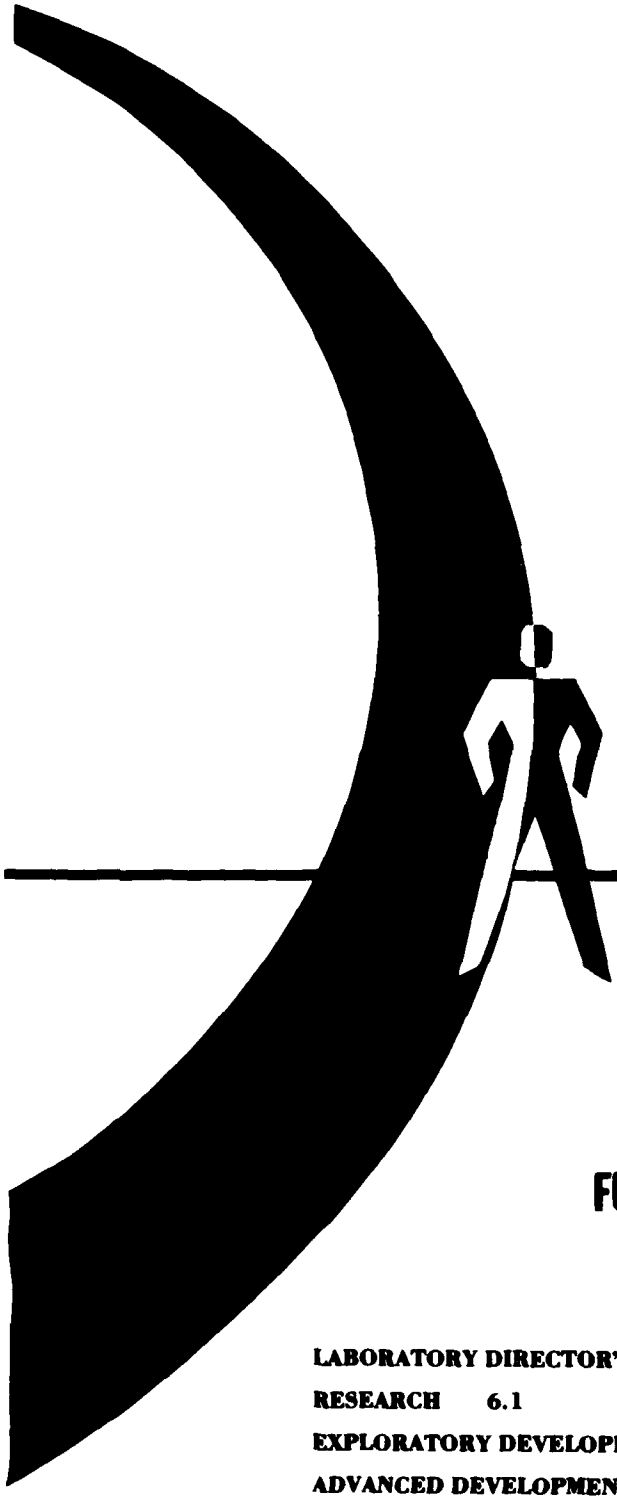
OFFICERS	79
AIRMEN	97
CIVILIANS	236
TOTAL	412



PERSONNEL TYPES



ACADEMIC DEGREES



FISCAL HIGHLIGHTS

FUNDING SUMMARY ($1000)

	FY 82	FY 83	FY 84
LABORATORY DIRECTOR'S FUND	825	790	815
RESEARCH 6.1	1,156	1,156	830
EXPLORATORY DEVELOPMENT 6.2	19,671	23,786	29,421
ADVANCED DEVELOPMENT 6.3	6,683	16,789	15,215
INTERSERVICE TRANSFERS & REIMBURSABLES	5,056	8,547	10,966
TOTAL	33,391	51,068	57,247

INVESTMENT STRATEGY

The investment strategy of AFHRL is predicated on four primary investment considerations:

1. Integration of Manpower, Personnel, Training, and Logistics technologies early in the weapon systems acquisition cycle through aggressive technology transition.

2. Adherence to a balance between technology base development and technology application in support of customer requirements.

3. Capitalization on emerging engineering technologies which directly impact the formulation and accomplishment of the R&D programs. Examples of these technologies are computer hardware and software, visual display technologies, and weapon systems design technologies.

4. The above considerations are reviewed in the larger context of support to the total AMD, AFSC, and Air Force missions.

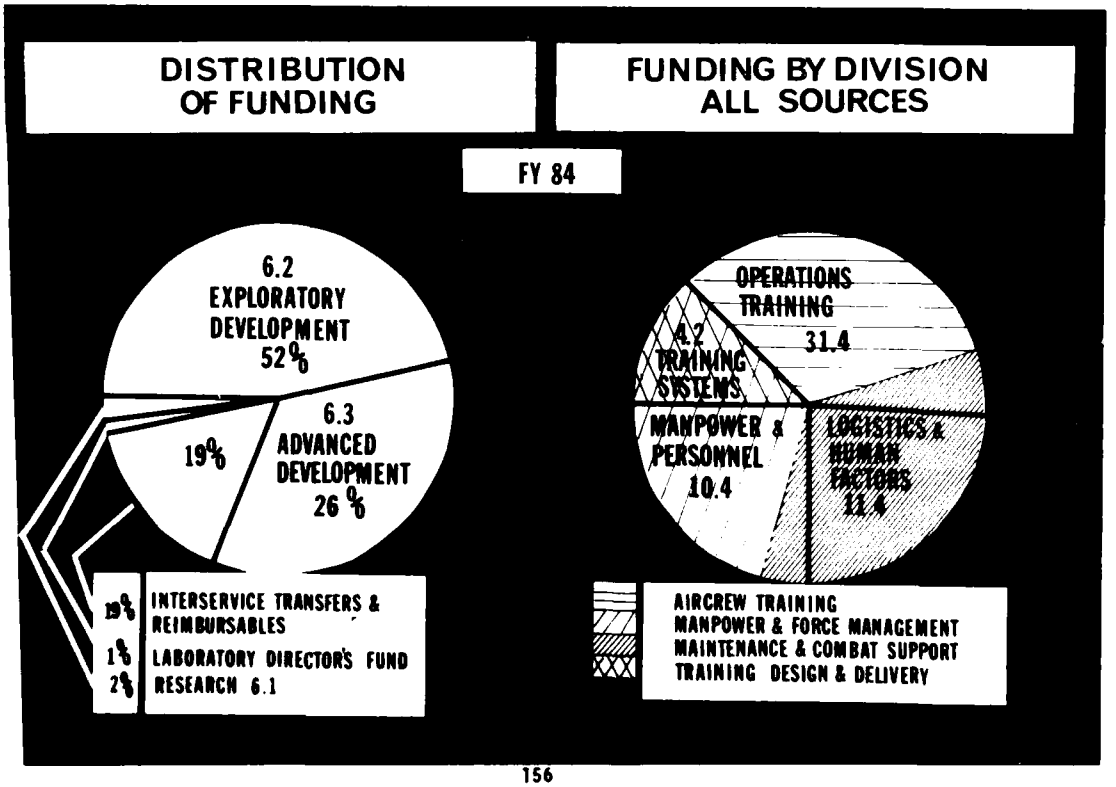
The AFHRL investment strategy is implemented through a planning and programming process which is organized around the DoD Planning, Programming and Budgeting System (PPBS). Advance planning is the primary method of assuring that R&D resources are invested in technologies that meet the needs of the Air Force in a timely manner. To this end, an AFHRL 18-month planning cycle is the implementing tool of the investment strategy. The following activities constitute this cycle:

1. Eighteen months in advance of the fiscal year in which an effort will start, division scientists prepare individual work unit proposals. Each proposal identifies and justifies the R&D being proposed, provides detail on the technical approach and specifies the technology to be enhanced or the customer requirement to be satisfied.

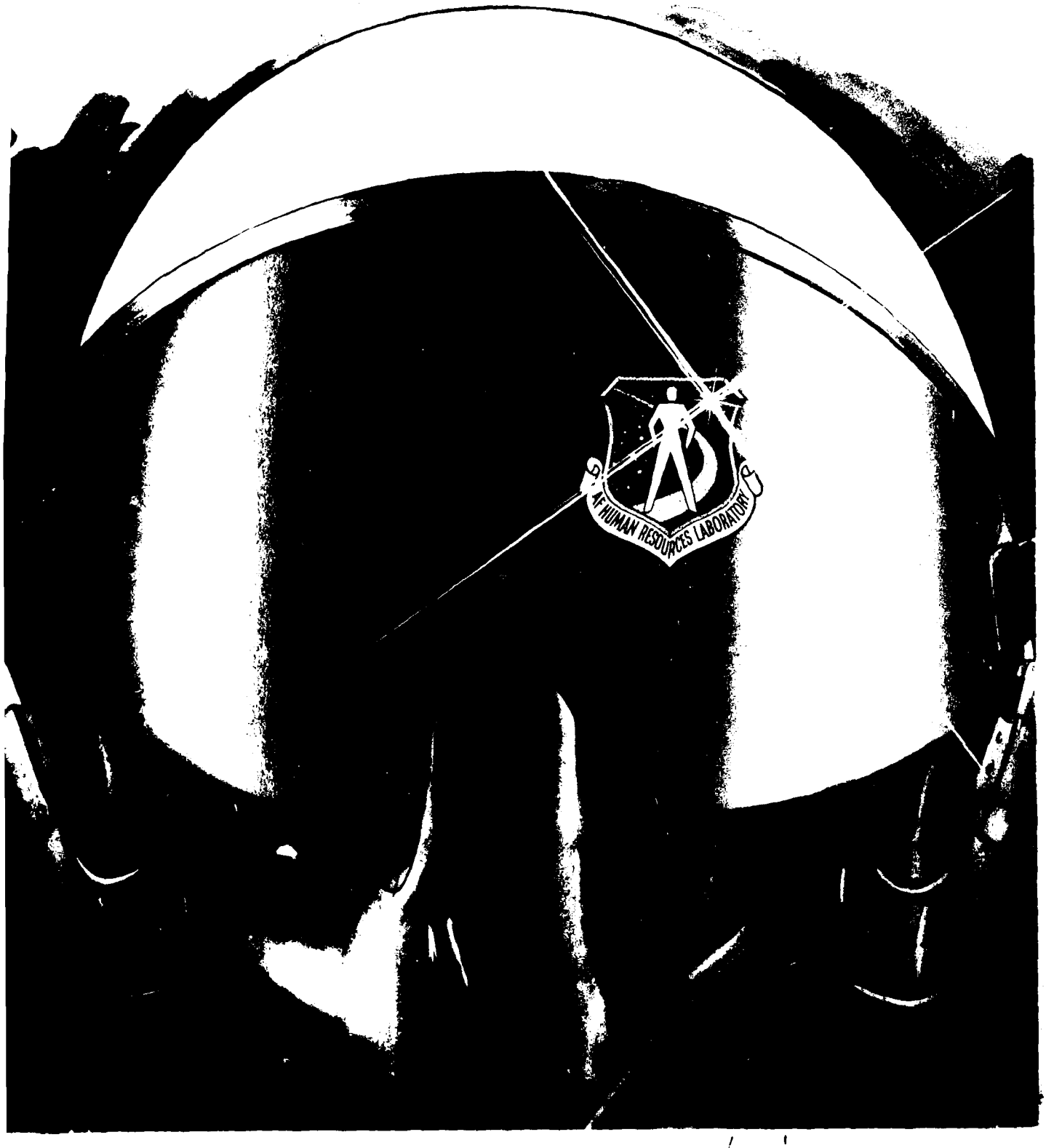
2. Program proposals are then reviewed by the laboratory Corporate Planning Group and may be tentatively approved.

3. Scientists then develop work unit plans which detail the technical proposals, resource requirments and justification for the effort. These plans are reviewed by the AFHRL Technical Advisory Board and by Research Advisory Panels of nationally recognized experts.

4. The final review is made by the Commander and the Corporate Planning Group Executive Committee approximately six months prior to the proposed program start. Approval is based on the priority of the program and the availability of resources.



DOCUMENTATION & PRESENTATIONS



AFHRL PUBLICATIONS

AFHRL publishes Technical Reports (TRs), Technical Papers (TPs), and Special Reports (SRs). All three kinds of reporting documents are available at the Defense Technical Information Center for qualified users and at the National Technical Information Service for the general public. These documents are announced in the Technical Abstract Bulletin and in the Government Reports Announcements and Indexes published by the two organizations, respectively. They are also announced in a Quarterly R&D Summary.

Technical reports are the documented results of Department of Defense sponsored research, development, test, and evaluation projects and communicate information generated as part of these projects. TRs are normally final reports. They document empirical findings that definitively resolve one or more R&D issues. TRs may include state-of-the-art reviews, dissertations, theses, or literature collections (including abstracts or annotated bibliographies.).

Technical Papers are interim reports. Examples of materials appropriate for TPs include computer documentation, concept papers, professional presentations, briefings, lessons learned (such as empirical studies with negative or inconclusive findings), papers or widely used reference publications distributed on a recurring basis, and technical memoranda, bulletins, notes or working papers having permanent value. A final report may be published as a TP if relatively limited distribution is desired or if the empirical findings do not definitively resolve an R&D issue.

Special Reports are aimed at and tailored to specific Air Force users. They summarize R&d findings, conclusions, and recommendations for implementation in concise, non-technical language, with full documentation appended or cited.

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Ballentine, R. D., & Lipscomb, M. S. (1984, August). Developing performance measures and standards for accurate assessment. The 92d Annual Convention of the American Psychological Association, Toronto, Canada.

Ballentine, R. D., Weaver, C. N., & Tuttle, T. C. (1984, November). A new measure of organizational productivity. Air Force/Navy Science Engineering Symposium, Norfolk, VA.

Bolz, R. (1984, August). Ada Workshop. Presented at the Interservice/Security Industrial Association Conference, Dayton.

Boynton, T. A. (1984, May). Probabilistic logic networks for R&D projects. Paper presented at the Institute of Management Sciences/Operations Research Society of America Conference, San Francisco, CA.

Burns, H. (1983, October). TOPOI: A demonstration and implications for critical thinking. Pennsylvania Association of Colleges and Universities, Hershey, PA.

Burns, H. (1984, February). English education and the electronic imagination. Keynote Address. Presented at the Arizona English Teachers Association Conference, Prescott, AZ.

Burns, H. (1984, February). The writer's intuition and artificialintelligence. Paper presented at the Conference on college composition and communication, New York, NY.

Carpenter, J. B., Pan, S. K., & Weaver, C. N. (1984, March). Marital status: A near-forgotten variable in explaining work-related attitudes. The Southwestern Society of Economists, San Antonio, TX.

Christal, R. E. (1983, November). Theoretical and methodological issues in the measurement of cognitive abilities with computers. Tri-Service Meeting on Computerized Testing, San Diego, CA.

Christal, R. E. (1984, August). Latency scores as ability measures. In D.L. Payne (Chair), The Air Force Learning Abilities Measurement Program (Project LAMP). Symposium at the 92nd Annual Convention of the American Psychological Association, Toronto, Canada.

Christal, R. E. (1984, August). The Air Force Learning Abilities Measurement Program (Project LAMP). In D.K. Detterman (Chair), Computer-Assisted Assessment of Cognitive Abilities. Symposium at the 92nd Annual Convention of the American Psychological Association, Toronto, Canada.

Cook, P. A., & Hanson, C. L. (1983, November). Training the multiple-aircraft combat environment. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Dallman, B. (1984, March). AI applications to maintenance: Some research implications for the cognitive science. Cognitive Science Synthesis Conference, Monterey, CA.

DeMaio, J. C., Bell, H. H. & Brunderman, J. (1983, October). Pilot oriented performance measurement. 27th Annual Meeting of the Human Factors Society, Norfolk, VA.

DeMaio, J. C., Bell, H. H., & Brunderman, J. (1983, November). Pilot oriented performance measurement. 5th Interservice/Industry Training Equipment conference, Washington, DC.

DeMaio, J. C., Rinalducci, E. J., Brooks, R. B., & Brunderman, J. (1983, October). Visual cueing effectiveness: Comparison of perception and flying performance. 27th Annual Meeting of the Human Factors Society, Norfolk, VA.

Edwards, B. J. (1984, February). Interactive video systems: A media research perspective. 2d Annual Air Force Conference on Technology in Training and Education, Sheppard AFB, TX.

Fahmy, S. B., & Weaver, C. N. (1984, March). What accountants want in a job: A comparative analysis of five nation-wide surveys. Southwestern Regional Meeting of the American Accounting Association, San Antonio, TX.

Gardner, G. Y. (1984, July). Simulation of natural scenes using textured quadric surfaces. 11th Annual Conference on Computer Graphing and Interactive Techniques (SIGGRAPH 84), Minneapolis, MN.

Geltmacher, H. (1983, November). Advanced visual technology system capabilities. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Gott, S. P. (1984, April). Training for high technology: What skills are basic to troubleshooting? American Educational Research Association, New Orleans, LA.

Gott, S. P., & Davis, T. S. (1983, November). Introducing specific knowledge domains into basic skills instruction: From generalized powers to specified knowledge. National Adult Education Conference, Philadelphia, PA.

Gould, R. B., & Hedge, J. W. (1984, August). History, background and theoretical bases of walk-through performance testing. 92d Annual Meeting of the American Psychological Association, Toronto, Canada.

Hanson, C. L. (1983, November). Fiber-optic helmet-mounted display: A cost-effective approach to full visual flight simulation. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Hanson, C. L., Longridge, T. M., Welch, B., Kruk, R. V., & Barrette, R. (1984, June). Fiber-optic helmet-mounted display: A breakthrough in full visual flight simulation. 1984 Society for Information Display International Symposium, San Francisco, CA.

Hedge, J. W. (1984, August). The methodology of walk-through performance testing. 92d Annual Convention of the American Psychological Association, Toronto, Canada.

Herner, A. E., & Demmy, W. S. (1984, August). Maintenance and Logistics im Computer Aided Design. Society of Logistics Engineers, Dayton Chapter Symposium, Dayton, OH.

Hubbard, D. C. (1984, March). Covariance analysis to psychophysical data. 10th Annual Mini-Symposium on Aerospace Science and Technology, American Institute of Aeronautics and Astronautics, Dayton, OH.

Hughes, R. G. (1983, October). Use of a flight simulator to estimate the effects of a simulated directed energy threat to A-10 close air support mission performance. Lasers on the Modern Battlefield, Letterman Army Institute of Research, San Francisco, CA.

Jones, R. J., Allen, G. L., & Morgan, B. B., Jr. (1984, March). Signs, samples, and point-to-point correspondence: An empirical test. Annual Meeting of the Southeastern Psychological Association, New Orleans, LA.

Kamchi, J. S., & Dube, W. M. (1983, November). The facility part of the equation. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Kellogg, R. S., Longridge, T. M., & Miller, M. (1983, October). Visual perceptual and human operator performance factors involved in low-level, high-speed flight. Human Factors Society Meeting, Norfolk, VA.

Kyllonen, P. C. (1984, March). The relationship between processing speed and learning. Office of Naval Research Annual Contractor's Meeting on Action, Attention, and Individual Differences in Information Processing Abilities, New Haven, CT.

Kyllonen, P. C. (1984, August). Dimensions of information processing speed. In D. L. Payne (Chair), The Air Force Learning Abilities Measurement Program (Project LAMP). Symposium at the 92nd Annual Convention of the American Psychological Association, Toronto, Ontario, Canada.

Lipscomb, M. S. (1984, August). A task-level domain sampling strategy: A content valid approach. The 92d Annual Convention of the American Psychological Association, Toronto, Canada.

Martin, D. R., Weaver, C. N., & Franz, R. S. (1984, July). The relationship between perceptions of economic conditions and reports of financial satisfaction: An explanatory study. The North American Economics and Finance Association, Mexico City, Mexico.

Mathews, J. J., & Valentine, L. D., Jr. (1983, October). Prediction of aptitudes from background data: Majority-minority comparions. Presented at the 25th Annual Conference of the Military Testing Association, Gulf Shores, AL.

McCormick, D., Martin, E. L., Smith, T., Lewandowski, F., & Prescar, W. (1983, November). Low altitude database development evaluation and research (LADDER). 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Nullmeyer, R. (1984, September). Model Aircrew Training Systems. SAC ISD Conference, Carswell AFB, TX.

Payne, D. L. (1983, November). Computerized measurement of learning rate. Tri-Service Meeting on Computerized Testing, San Diego, CA.

Payne, D. L. (1984, March). Air Force research on individual differences in learning abilities. Tri-Service Cognitive Sciences Synthesis Conference, Monterey, CA.

Payne, D. L. (1984, August). Learning rate and interference effects. In D. L. Payne (Chair), The Air Force Learning Abilities Measurement Program (Project LAMP). Symposium at the 92nd Annual Convention of the American Psychological Association, Toronto, Canada.

Pellegrino, J. W. (1984, August). Individual differences in information processing efficiency. In D. L. Payne (Chair), The Air Force Learning Abilities Measurement Program (Project LAMP). Symposium at the 92d Annual Convention of the American Psychological Association, Toronto, Canada.

Pitts, E. W., Morgan, B. B., Jr., & Dickinson, T. L. (1984, March). Using the J-coefficient to assess performance on complex experimental learning tasks. Annual Meeting of the Southeastern Psychological Association, New Orleans, LA.

Pohlman, D. (1984, September). Interactive graphics simulator. Defense Computer Graphics Conference, Washington, DC.

Polzella, D. J. (1984, May). Aircrew training devices: Utility and utilization of advanced instructional features. Southern Ohio Chapter of Human Factors Society Meeting, Dayton, OH.

Polzella, D.J., & McLean, C. H. (1983, November). Utility and utilization of advanced instructional features in aircrew training devices: Tactical Air Command. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

Rockway, M. R., & Nullmeyer, R. T. (1984, March). Training effectiveness evaluation of the C-130 weapon system trainer wide-angle visual system. 10th Annual Mini-Symposium of Aerospace and Technology, American Institute of Aeronautics and Astronautics, Dayton, OH.

Smith, B. R. (1984, January). Digital head tracking and position prediction for helmet-mounted visual display systems. American Institute of Aeronautics and Astronautics Conference, Reno, NV.

Stober, S.R., Welch, B., Kruk, R.V., & Longridge, T. M. (1984, May). The fiber-optic helmet-mounted display. Royal Aeronautical Society, London, England.

Varela, G., Weaver, C. N., & Franz, R. S. (1984, March). TV viewing habits of the Hispanic. The Southwestern Marketing Association, San Antonio, TX.

Waag, W. L., & Hubbard, D. C. (1984, April). The measurement of C-5 aircrew performance. 9th Psychology in the DoD Symposium, USAF Academy, CO.

Widder, P. A., & Stephans, C. W. (1983, November). Data base generation: Improving the state of the art. 5th Interservice/Industry Training Equipment Conference, Washington, DC.

CONFERENCES/WORKSHOPS HOSTED BY AFHRL IN FY84

June 1984	Automated Technical Information Conference Air Force Coordinating Office for Logistics Research Wright-Patterson AFB, Ohio
May 1984	Computer Adaptive Testing Interservice Coordinating Committee Brooks AFB, Texas
30 May - 1 June 1984	Industry, Military, Aerospace, Government, and Education (IMAGE) III Conference Phoenix, Arizona
January 1984	Joint-Services Selection and Classification Working Group Brooks AFB, Texas
October 1983	Symposium on Artificial Intelligence in Maintenance Boulder, Colorado
August 1984	Symposium on Near Infrared Photometry Lowell, Michigan
July 1984	Symposium on the Case of Microcomputers in Real-time Control Fairborn, Ohio
September 1984	Technology Task Group Emergency Meeting Joint-Services Selection and Classification Working Group Brooks AFB, Texas

DIRECTORY

Colonel Anthony F. Bronzo, Jr.
Commander
AFHRL/CC
Brooks AFB, TX 78235
(512) 536-2665
AUTOVON 240-2665

Colonel Tyree H. Newton
Vice Commander
AFHRL/CV
Brooks AFB, TX 78235
(512) 536-3605
AUTOVON 240-3605

Dr. Earl A. Alluisi
Chief Scientist
AFHRL/CCN
Brooks AFB, TX 78235
(512) 536-3605
AUTOVON 240-3605

Dr. Herbert J. Clark
Director, Plans & Programs Office
AFHRL/XR
Brooks AFB, TX 78235
(512) 536-3611
AUTOVON 240-3611

Major Thomas A. Boynton
Director, Analysis & Evaluation Office
AFHRL/OA
Brooks AFB, TX 78235
(512) 536-3942
AUTOVON 240-3942

Mr. Robert L. Eady
Chief, Executive Support Service
AFHRL/SU
Brooks AFB, TX 78235
(512) 536-3386
AUTOVON 240-3386

Colonel Carl D. Eliason
Chief, Operations Training Division
AFHRL/OT
Williams AFB, AZ 85224
(602) 988-6561
AUTOVON 474-6561

Dr. Nancy Guinn
Chief, Manpower & Personnel Division
AFHRL/MO
Brooks AFB, TX 78235
(512) 536-2244
AUTOVON 240-2244

Colonel Donald C. Tetmeyer
Chief, Logistics & Human Factors Division
AFHRL/LR
Wright-Patterson AFB, OH 45433
(513) 255-6797
AUTOVON 785-6797

Colonel Graham P. Crow
Chief, Training Systems Division
AFHRL/ID
Lowry AFB, CO 80230
(303) 370-2955
AUTOVON 926-2955

Dr. Robert A. Bottenberg
Chief, Technical Services Division
AFHRL/TS
Brooks AFB, TX 78235
(512) 536-3841
AUTOVON 240-3841

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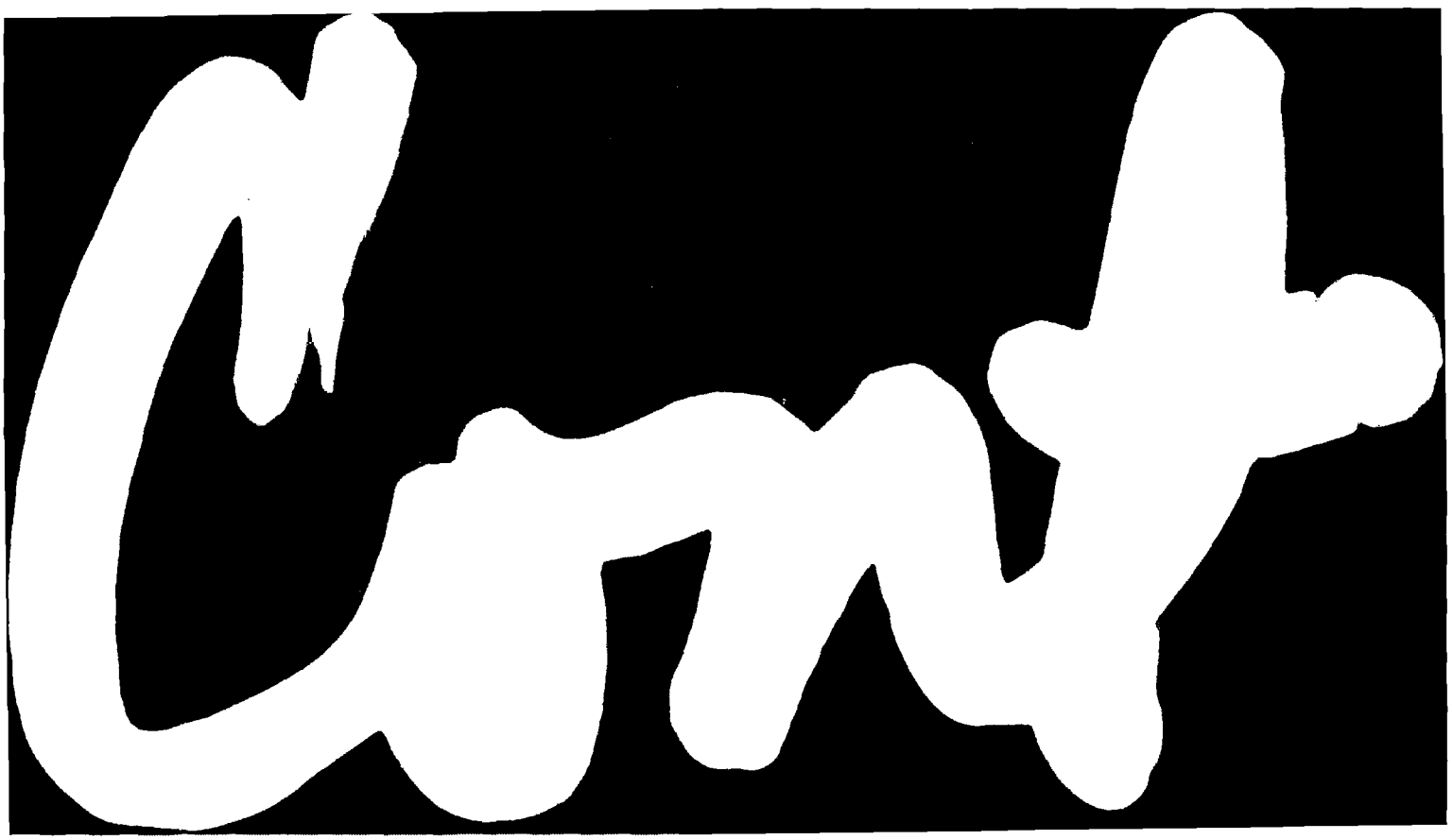

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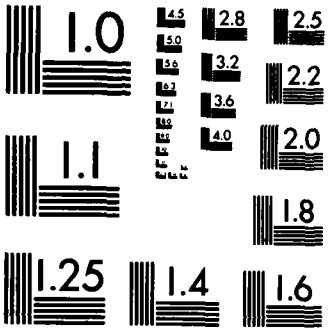

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SUPPLEMENTARY

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AIR FORCE HUMAN RESOURCES LABORATORY
ANNUAL REPORT - FISCAL YEAR 1984

Ruth M. Buescher

TECHNICAL SERVICES DIVISION
Brooks Air Force Base, Texas 78235-5601

July 1985

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19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

This paper presents the Air Force Human Resources Laboratory (AFHRL) mission, corporate philosophy, and descriptions of its research and development (R&D) thrusts. Fiscal Year 1984 technical achievements and ongoing R&D are organized under each thrust area. It further outlines the AFHRL organizational structure, functions of divisions and staff offices, and available technical resources. It lists publications and presentations by Laboratory personnel during Fiscal Year 1984.

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22a. NAME OF RESPONSIBLE INDIVIDUAL Nancy A. Perrigo, Chief, STINFO Office	22b. TELEPHONE (*Include Area Code*) (512) 536-3877	22c. OFFICE SYMBOL AFHRL/TSR

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manpower and force management
ongoing research and development
organization
publications and presentations
technical achievements Fiscal Year 1984
technical support
weapon systems logistics maintenance and technical training

AFHRL Technical Paper 85-29 July 1985

AIR FORCE HUMAN RESOURCES LABORATORY
ANNUAL REPORT - FISCAL YEAR 1984

Ruth M. Buescher

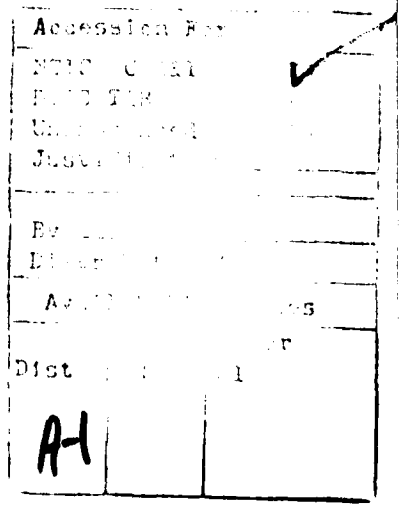
TECHNICAL SERVICES DIVISION
Brooks Air Force Base, Texas 78235-5601

Reviewed by

Nancy A. Perrigo
Chief, Scientific and Technical Information Office

Submitted for Publication by

Dr. Robert A. Bottenberg
Chief, Technical Services Division



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